Richard A. Hernandez, Jr.
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July 31, 2014

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Environmental and Natural Resources Section
U.S. Department of Justice
Box 7611 Ben Franklin Station
Washington, DC 20044

Director, Air Enforcement Division
Office of Civil Enforcement
U.S. Environmental Protection Agency
Mail Code 2242-A
1200 Pennsylvania Avenue, N. W.
Washington, DC 20460

Air and Radiation Division
EPA Region 5
77 W. Jackson Blvd. (AE – 17J)
Chicago, IL 60604
Attn: Compliance Tracker

Director
Air, Pesticides and Toxics Management Division
EPA Region 4
61 Forsyth Street (4APTMD-AEEB)
Atlanta, Georgia 30303

RE: CRLLC CD Waste Gas Minimization Plan Submittal
Marathon Petroleum Company, LP

EPA Officials:

Marathon Petroleum Company, LP (MPC) Catlettsburg Refining, LLC (CRLLC) would like to submit the Waste Gas Minimization Plan (WGMP) as required by Paragraph 30 of the Consent Decree (CD) between U.S. Environmental Protection Agency (EPA) and MPC.

The enclosed WGMP discusses MPC anticipated reductions of the vent gas and waste gas flow rates for its refinery-wide flares.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

For further discussion of these plans or questions, please contact Byron Bazemore 606-921-2420.

Sincerely,

Richard A. Hernandez, Jr.

Richard A. Hernandez, Jr.
Refining General Manager

cc: James Wilkins, MPC
James Manning, MPC
Virginia King, MPC

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BAB JBP MSA
BAB/JBP/MSA

Marathon Petroleum Company LP

WASTE GAS MINIMIZATION PLAN

Catlettsburg Refining, LLC

Catlettsburg, KY

Alky, FCC, Lube and NNA Flares

Revision 1

July 31, 2014

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Figures:

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Attachments

LIST OF ACRONYMS

Alky - Alkylation
BTU – British Thermal Units
CD – Consent Decree
DDS – Diesel Desulfurization Unit
DCS – Distributed Contrl System
FCC – Fluidized Catalytic Cracking
FWS – Foul Water System
GC – Gas Chromatograph
GE- General Electric
HPVGO – High Pressure Vacuum Gas Oil
HPCCR – High Pressure Continuous Catalytic Reformer
ISOM – Isomerization
KDS – Kerosene Deasphalting
KO – Knock Out
LBS - Pounds
LPVGO – Low Pressure Vacuum Gas Oil
MOC – Management of Change
MPC – Marathon Petroleum Company, LP
NNA – New North Area
NPT – Naphtha Pretreater
PChem – Petrochemical
SCF – Standard cubic foot
SCFD – Standard cubic feet per day
SCFH – Standard cubic feet per hour
SCFM – Standard cubic feet per minute
SDU – Solvent Deasphalting Unit
SRU – Sulfur Recovery Unit
TCD – Thermal Conductivity Detector
USEPA – United States Environmental Protection Agency
WGMP – Waste Gas Minimization Plan

Executive Summary

In the past, Marathon Petroleum Company LP's (MPC's) Catlettsburg Refining, LLC (CRLLC) has achieved reductions in flare emissions through implementation of work practices and equipment reliability programs designed to minimize the need to send waste gas to flare. Additionally, flare monitoring and efficiency measures have been implemented to further increase flare effectiveness and reduce emissions. Specifically, these measures include the installation of pilot, flow and content monitoring devices (i.e., volumetric flow meters, gas chromatographs, pilot flame monitoring, etc.) and integrated steam controllers. This Waste Gas Minimization Plan (WGMP) was created to document the historical progress and the plan for future progress to minimize flaring events in the future.

The goal of this WGMP is to describe procedures to be implemented at CRLLC to reduce the frequency of flaring events, reduce the volume of waste gas generated during flaring events, and increase waste gas quality. An evaluation of historical flaring events and actions taken to help control the volume of waste gas sent to flare at the facility is provided herein. The WGMP provides data sets that were used to evaluate progress in reducing flaring events and waste gas flow. It details the procedures to be used to continually improve upon the goal of reducing emissions from flaring.

1.0 Introduction

The CRLLC facility, located at 11631 US 23 South in Catlettsburg, Kentucky, refines crude oil into various petroleum products and is organized into several groups of process units, designed to maximize the production of transportation fuels. Figure 1 shows the CRLLC general process flow diagram for the refinery. The refining process utilizes physical and chemical reactions which require increased temperatures and/or pressures. Critical elements of most process equipment are pressure relief devices used to ensure process equipment do not become over pressurized and create a safety hazard. To limit the emission of hydrocarbon constituents from these relief devices, they are collected in a header system and processed in a safe manner in a refinery flare system. Refinery flares are designed to accept a broad range of gas flow rates and compositions which may result from emergency conditions or small leaks in relief devices. Flare systems vary greatly depending on the application and specific conditions present in the process unit having connections to the flare header system.

Each flare system consists of a relief gas header system, otherwise referred to as a "flare header system" or "waste gas header system," which provides a controlled outlet for any excess vapor flow. Each relief gas header has connections to depressurization and purging relief devices related to maintenance turnaround, startup, and shutdown, as well as other pressure relief devices and safety control devices to handle emergency situations. Typically relief gas header systems incorporate a knockout drum for separation of liquids entrained in the waste gases. Liquids can cause damage to flare systems and create a serious safety concern. Liquids from the knockout drum are sent for treatment and then recycled back into the refinery process. Gases are routed to the flare tip or to flare gas recovery devices.

Keeping air from leaking into the system is critical to preventing excess oxygen from entering the relief flare header. This is typically accomplished by maintaining a slightly positive pressure in the header with a supplemental gas sweep on a major header if existing process flows are inadequate.

Combusted gas exits the flare via a tip which is specially designed to promote combustion over a range of flow rates and reduce noise. Steam is used to increase mixing at the flare tip, improve combustion efficiency, and reduce smoking. Refinery fuel gas is used at the flare tip to keep a pilot light burning and to provide a positive pressure at the flare tip to promote upward flow.

Properly designed and operated flare systems can achieve greater than 98 percent combustion efficiency within certain operating parameters, producing mainly carbon dioxide (CO_2) and water. Other compounds may be present depending on the source of the flow to the flare. For example, sulfur dioxide (SO_2) may be present if there are sulfur-containing compounds present in the waste gas.

1.1 CRLLC Flare Systems

Flare systems are essential, safety equipment used at the refinery to combust gases that would otherwise be released to the environment. Without the combustion that flares are designed to provide, potentially dangerous gases could be released creating potential health hazards to workers and the community. Additionally, released gases create a fire hazard if not properly handled and controlled through a flare system. The gases handled by flare systems are released from relief valves, pump seals, and many other devices designed to keep the refinery safe and reduce fugitive emissions.

CRLLC has four (4) process flare systems which are subject to this Waste Gas Minimization Plan (WGMP). These flares are the:

- New North Area (NNA) Flare (2-11-FS-2);
- Lube Petrochem Flare (1-14-FS-3);
- Fluid Catalytic Cracking (FCC) Flare (2-11-FS-4); and
- Alkylation (Alky) Unit Flare (2-11-FS-3).

The above flares were designed to serve specific process units in the refinery with various quantities and compositions of waste gas being routed to them.

1.2 Waste Gas Minimization Plan Requirements

MPC and its wholly owned subsidiary, CRLLC, entered into a Consent Decree (CD) with the United States Environmental Protection Agency (USEPA), which became effective on August 30, 2012. The CD contains specific and comprehensive compliance measures for flare systems at each of the six (6) MPC refineries. The purpose of these measures is the cessation of the alleged violations contained within the CD. Each flare system subject to the measures of the CD (e.g., Covered Flare) is identified in Appendix 2.1 of the CD.

One of the measures contained within the CD is the preparation of a WGMP that documents specific information regarding each covered flare system at each of the six (6) MPC refineries. The WGMP for CRLLC's flares is to be submitted to the USEPA by July 31, 2013 as provided in Column D of Appendix 2.1. Subsequent updates to the WGMP must be submitted annually on the anniversary of the required submission date of the initial WGMP until the termination of the CD. The first update is due by July 31, 2014, as specified in Column E of Appendix 2.1.

This WGMP fulfills the requirements of the CD regarding the development of a written WGMP for the NNA, Lube, FCC and Alky Flares, identified as NNA 2-11-FS-2, Lube Petrochem 1-14-FS-3, FCCU 2-11-FS-4, and HF Alkylation 2-11-FS-3 and has been prepared pursuant to the requirements and provisions of the CD. Appendix A includes a table that cross-references the requirements of the CD and their locations within this WGMP.

The following information is specifically required to be included in or referenced by this WGMP:

- Updates to the Flare Data and Monitoring Systems and Protocol Report;
- Waste Gas Characterization and Mapping;
- Reductions Previously Realized;
- Planned Reductions;
- Prevention Measures; and,
- Flares Taken Out of Service.

CRLLC must maintain a copy of the current WGMP for all covered flares. Each subsequent update to the WGMP must include, any information that becomes available during the period following the submission of the previous WGMP. All information contained within or referenced by this document should be reviewed to determine which information must be updated. This may include, but not be limited to, the following:

- Updated Waste Gas Mapping;
- Reductions Based on Root Cause Analysis; and,
- Revised Schedule for Installation or Implementation of Reductions.

A Plan Revision History Log is included in Appendix B. The log may be utilized to document all changes to the WGMP, including the specific information updated in each subsequent update, and the date on which the WGMP was submitted to the USEPA.

The Consent Decree stipulates that the elements of a WGMP include:

- A schedule for submitting updates to the information previously issued in the Flare Data and Initial Monitoring Systems Reports for each flare;
- Information regarding each tie-in to flare header systems;
- Available data on volumetric flow sent to each flare over the past year prior to thirty (30) days before the date of the initial WGMP submittal;
- A description of the equipment, processes, and procedures installed or implemented to reduce flaring events over the past year prior to thirty (30) days before the submittal date of the initial WGMP submittal;
- A discussion of the process of conducting root cause analyses (RCA) for reportable flaring events and using these analyses to further reduce the occurrence of flaring events;

- Identification of any flares that will be taken out of service and a schedule for completion of decommissioning;
- Identification of equipment, processes, and procedures that MPC plans to install or implement to reduce flaring events in the future, along with a schedule for completion of these plans;
- Discussion of preventive measures to address the following:
    - Flaring that has occurred during maintenance activities (including shutdown and startup); and
    - Flaring caused by recurrent failure of air pollution control devices, process equipment, or processes that fail to operate in a normal or usual manner.

2.0 Flare Systems Information

2.1 NNA Flare (2-11-FS-2)

2.1.1 Equipment and Controls

The NNA Flare was installed in June 1970 and is currently equipped with a John Zink design tip. The original installation consisted of an elevated, steam-assisted, flare and an ignition system, as well as, associated piping for the steam ring, pilot gas, and three ignition tubes. The elevated NNA Flare stack consists of a 36-inch diameter flare riser at a length of 185 feet. The total height of the flare stack assembly is 197.19 feet, and is self-supported. The STF-S-36 flare tip assembly was installed in 1998 by John Zink. The flare tip has a diameter of 36 inches and a length of 12 feet and 3 inches. It includes a 6-inch upper steam manifold connection, including an upper steam ring, steam risers, and steam spider tips. The 6-inch steam riser splits into 39 steam jets. Also included is a two inch pilot gas manifold connection with three 1 inch pilot and ignition gas connections. The steam supply piping is 6-inch diameter pipe rated for up to 450 pounds of steam. The most recent physical changes to the flare involved replacement of the flare tip in 1998. The NNA Flare treats vent gases from approximately 29 control valves, 304 relief valves, 3 pump seals, 15 compressor seals, 14 sample stations, and other flows generated via maintenance or turnaround.

The NNA Flare is fed from two primary headers with a main knockout drum on each header. The NNA Flare header feeds into the 'New' NNA flare drum (11-F-14), which is a horizontal vessel with an internal diameter of 12 feet, and a nominal length of 36 feet. The NNA Flare header also feeds into the 'Old' NNA Flare Drum (11-F-9) which is a horizontal vessel with an internal diameter of 9 feet 10.75 inches, and a nominal length of 36 feet. Two smaller knockout drums are located on unit subheaders and include the Solvent Deasphalting Unit (SDA) Flare Drum (31-F-27) and DDS Flare Drum (31-F-5). A simplified process flow diagram depicting the various sources of flow to the NNA Flare is included as Appendix C.

The two headers feeding the two smaller knockout drums are interconnected to allow flow to travel through either one of the headers. Flow can fluctuate depending on the pressure gradient present in the line at the time of the event. The combined header is fed by:

- #3 Crude Unit relief valves
- #2 Sulfur Recovery Unit (SRU) header
- Diesel Desulfurization Unit (DDS) header
- Propane bullets
- SDA flare drum
- #1 Sulfur Recovery Unit (SRU) header
- Isomerization Unit (ISOM) header
- Low Pressure Vacuum Gas Oil Unit (LPVGO) header

- Hydrogen Plant header
- 18" Kerosene Deasphalting Unit (KDS) header
- 12"Kerosene Deasphalting Unit (KDS) header
- High Pressure Vacuum Gas Oil Unit (HPVGO) header
- Naphtha Pretreater (NPT) header
- Foul Water System (FWS) header

A series of monitoring instruments including vent gas, purge gas, and steam flow meters, and a Siemens MAXUM™ Edition II gas chromatograph with a thermal conductivity detector (GC/TCD) analyze the inputs to the flare header prior to the flare tip. The vent gas flow reading, along with information regarding composition from the GC/TCD, is used to signal the steam controller to adjust the amount of steam sent to the flare tip. Adjusting the amount of steam allows the flare to operate with optimal conditions to ensure proper combustion efficiency (i.e. greater than 98%). Additionally, recording flow rates and compositions allow MPC to evaluate the potential sources of flow more accurately and develop strategies for eliminating or reducing vent gas flow.

The NNA Flare services process units in the NNA, H-Coal and Crude/Utilities areas. The major process units that discharge to the flare include:

- DDS Unit 2-121
- SDA Unit 2-031)
- #1 SRU Units 2-106/107,
- #2 SRU Units 2-119/120
- Isomerization Unit 2-035
- LPVGO Unit 2-103
- HPVGO Unit 2-104
- KDS Unit 2-122
- NPT Unit 2-101)
- High Pressure Continuous Catalytic Reformer (HPCCR) Unit 2-102
- Boiler #10
- Boiler #12
- Propane Bullets
- Portion of the #3 Crude Unit 2-023.

2.1.2 Waste Gas Volumetric and Mass Flow Rates

The waste gas volumetric and mass flow rates can be determined for the flare systems by utilizing an ultrasonic flow meter and GC/TCD. The volumetric flow rate of the vent gas can be derived by an ultrasonic flow meter by determining the vent gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The mass flow rate of the vent gas can be derived by an ultrasonic flow meter which uses the mass flow rate of the vent gas and utilizes the calculated vent gas molecular weight. The GC/TCD allows for the calculation of the waste gas volumetric and mass flow rates by determining the composition of the vent gas. Inert species within the vent gas (hydrogen, oxygen, nitrogen, carbon monoxide and carbon dioxide) can be excluded from the calculations. The average waste gas volumetric flow and mass flow rates for the NNA Flare was determined for the 30-day period between July 1, 2013 and June 30, 2014. Figures 2 and 3 below show the volumetric and mass flow rates of the NNA flare.

During the averaging period, turnarounds in the HPVGO, SDA and #2 SRU occurred contributing to higher flare flows during start-up and shutdown of these units. Procedures and projects are being evaluated to help limit the waste gas sent to the flare during these events. Since 2009, the NNA Flare has had two (2) NPT turnarounds, two (2) HPCCR turnarounds, two (2) #2 SRU turnarounds, two (2) SDA turnarounds, two (2) LPVGO turnarounds, four (4) HPVGO turnarounds, one (1) #3 Crude/Vac Unit turnaround, one (1) #1 SRU turnaround, and (1) DDS turnaround planned.

Figure 2: NNA Flare Waste Gas Volumetric (30 Day Rolling Average)

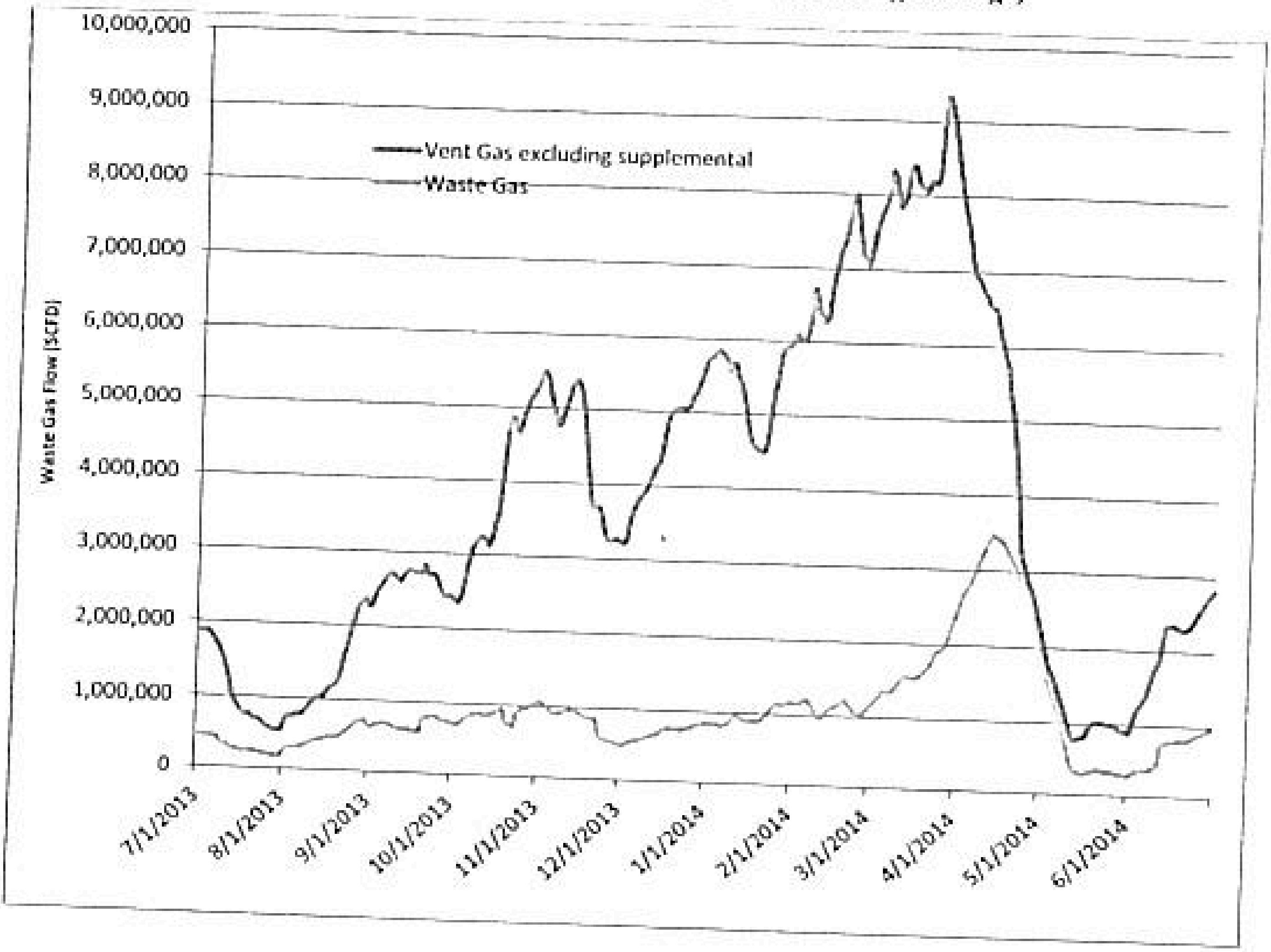
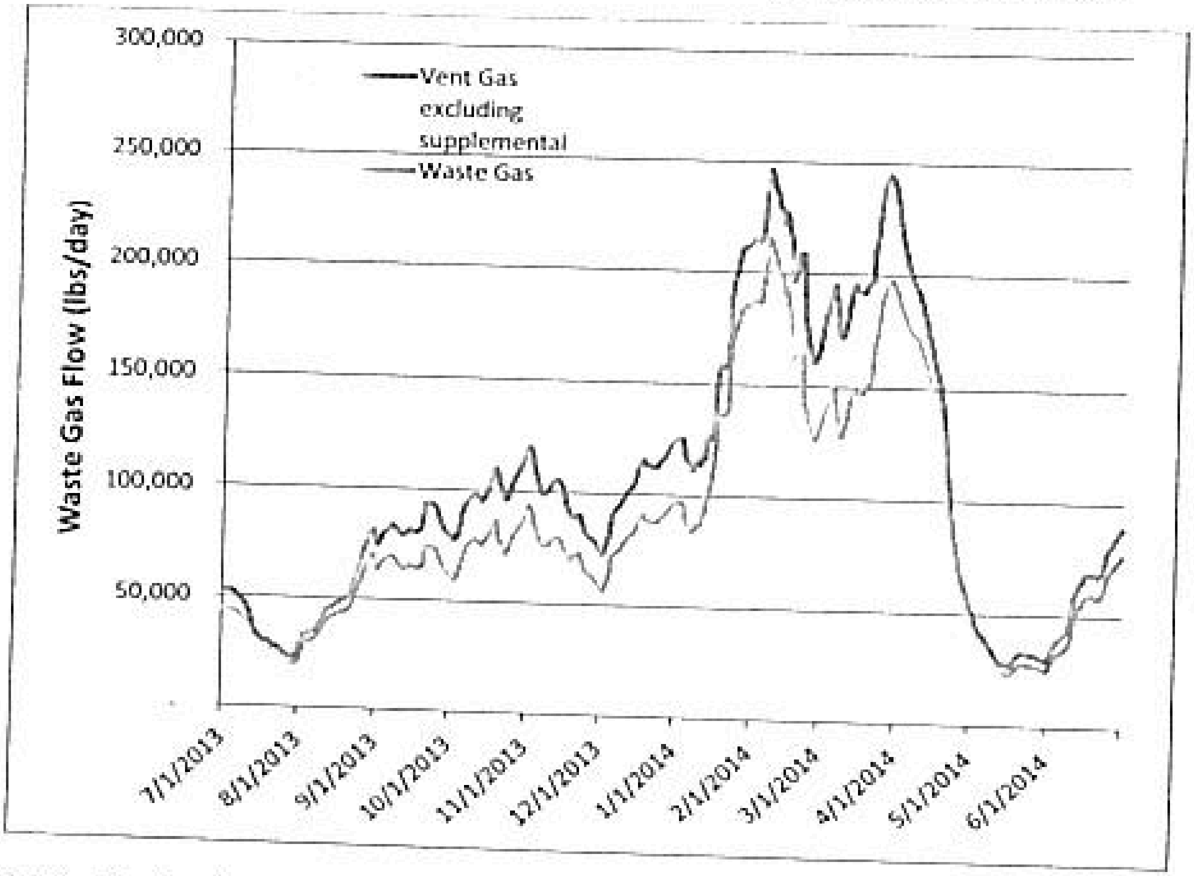


Figure 3: NNA Flare Waste Gas Mass Flow Rates (30 Day Rolling Average)



2.1.3 Baseload Waste Gas and Vent Gas Flow Rates

The baseload waste gas flow rate can be determined for the flare systems by utilizing an ultrasonic flow meter and GC/TCD. The flow meter is capable of calculating the volumetric flow rate of the vent gas by determining the vent gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC/TCD allows for the calculation of the waste gas volumetric flow rate by determining the composition of the vent gas. Inert species within the vent gas (hydrogen, oxygen, nitrogen, carbon monoxide and carbon dioxide) can be excluded from the calculations. The waste gas flow rate reflects only the volatile organic compound (VOC) content of the overall vent gas composition. The average baseload waste gas flow rate for the NNA Flare was determined to be 925,473 standard cubic feet per day (scfd) and the average baseload vent gas flow rate was determined to be 3,033,228 scfd for the time between July 1, 2013 and June 30, 2014.

Events that have been excluded from the base load calculation include:

- 8/22/2013 DDS compressor shutdown
- 10/15/2013 DDS Compressor Start up
- 1/7/2014 Extreme cold weather event
- 2/10/2014 DDS 121-PSV-10 relieving to flare

- 2/27/2014-3/1/2014 SDA Shutdown
- 3/8/2014 31-PSV-74 from the SDA lifted to the flare during start up
- 4/24/2014 DDS 121-PSV 69A lifted to the flare
- 5/7/2014 Shutdown of SDA compressor
- 6/10/2014 – 6/13/2014 Refinery Wide Power Outage

2.1.4 Identification of Constituent Gases

Under normal refinery operating conditions, gases vented to the flare from the various refinery units have a typical composition. This gas composition varies between flares due to the difference in the functions of the units each flare services. Gas composition is determined through the use of a GC/TCD. This average composition can vary during flaring incidents related to startup, shutdown, maintenance and turnaround activities, as well as emergency flaring situations. The following compositional analysis is what is typical for the NNA Flare.

Table 1: NNA Flare Base Load Constituents

Component	Average Mole %
Hydrogen	66.3
Oxygen	0.02
Nitrogen	2.2
Methane	15.5
Carbon Monoxide	0.01
Carbon Dioxide	0.08
Ethane	4.8
Ethylene	0.8
Acetylene	$2.0*10^{-4}$
Propane	3.9
Propylene	0.20
i-Butane	1.05
n-Butane	1.4
i-Butene, Butene-1	0.03
trans-Butene-2	0.01
cis-Butene-2	0.01
1,3-Butadiene	0.03
i-Pentane+	3.5
Hydrogen Sulfide	$6.0*10^{-4}$

2.1.5 Waste Gas Mapping

Waste gas mapping of the NNA Flare header was conducted on December 6-8, 2011 through the use of isotropic tracing. Tracerco Diagnostics was on site to conduct a flow study by injecting a suitable radiotracer into the flare system and monitoring the movement of the tracer using radiation detectors mounted externally on the wall. The data provided by the Tracerco Diagnostics study allowed for flow velocity and volumetric flow rates to be determined, as well as the identification of losses and leaks to the flare systems. All flare header lines that were six inches or greater were mapped that had accessible injection points.

The map provided in Appendix C indicates the waste gas flows for the NNA Flare. Flows for each process unit branch line were estimated using the following hierarchy based on the best data available.

1. Tracerco Data- Not all flare headers had available taps for Tracerco injections to occur, however this data was determined to be the best available data for streams where it was available.
2. Tracerco Data distributed to process units based on unit component counts- If Tracerco data was available for a header that had multiple process units tied into it, the Tracerco data was flow was divided amongst those process units based on component counts.

3. Maximum known flow from a large vent gas contributor- If a control valve associated with a process unit had a flow meter associated with the valve, the maximum flow rate associated with this flow meter was used.
4. Flow indications- Flow indicators, which were brought on line for multiple unit headers in 2013 are used to indicate increases in flow. Engineering estimates based on flow indication changes and the header diameter were used if available.
5. AP-42 component uncontrolled leak rates- If none of the above data was available, flow rates were determined using AP-42 leak rates for components in light liquid and gas services. Sample station leak rates, relief valve leak rates to atmosphere, pump seal leak rates, compressor seal leak rates, and open ended line leak rates (used for estimating block valve emissions) were used.

It is of note that flows that are based off of the Tracerco study are only a snapshot in time, and that it is possible for the flows to change depending on process unit events.

2.1.6 Historic Emission Reductions

Provided below is a listing of preventive measures completed over the past 5 years. These reductions represent a good faith effort by MPC to reduce flaring prior to the requirements of the CD. Where possible, an estimate of the reduction is provided. Subsequent updates to this document will list all previously completed or implemented actions conducted prior to the revision date. All of the below projects reduce flaring because they reduce process unit upsets.

Table 2: NNA Flare Reductions Previously Realized

Date Installed or Implemented	Description
2/2013	Fixed leaking recycle hydrogen control valve 102-HC-99 in HPCCR. This resulted in an estimated 700,000 scfd reduction in vent gas flow and an average estimated 60,000 scfd waste gas.
3/2013	Flow indication was added to the fuel gas purge on the HPVGO feed drum. This allowed for better control of flow going to the flare off of the drum. This has decreased waste gas production by an estimated 100,000 scfd.
8/2012	Fuel gas knock out (KO) pots 101-F-7 and 122-F-7 were double blocked on the blowdowns. This prevents potential excess fuel gas from getting into the flare system.
8/2012	In the KDS, the overhead receiver, the recycle hydrogen, the makeup hydrogen, and the stripper overhead liquids sample stations have all been labeled with a sign warning operations personnel to only use vent to flare when depressuring a sampling device. These vents were routinely left open.
8/2012	In the Isom, hydrogen knock out pots F-4 and F-6 are now blocked in to the flare rather than continuously cracked. These were cracked to keep from having to drain the pots.

8/2012	In the Hydrogen Plant, F-1, F-7, and F-8 are now closed unless the level in the drums gets high enough to need to be drained.
8/2012	The HPCCR debutanizer offgas control valve PCV-8 was leaking through to the flare slightly. The valve has been double blocked in and will only be unblocked when needed.
8/2012	HPCCR debutanizer offgas sample station has been labeled with a sign warning to only use vent to flare when depressuring a sampling device. These vents were routinely left open.

2.1.7 Flare-Specific Planned Reductions

CRLLC is currently in the evaluation stages on multiple projects to reduce the overall waste gas prior to the June 30, 2016 waste gas limit deadline. The evaluations listed below will be complete by June 30, 2016:

- Install deinventory piping to limit flaring during planned unit outages for all process areas associated with the NNA flare system.
- Install piping system to allow recycle hydrogen off of the HPCCR high pressure feed drum to be routed to the sour fuel system.
- Install a back-up compressor to 2-35-GC-17 to handle butane when the SDA butane compressor shuts down.
- Install a flare gas recovery system.

All four flare systems have had flow indication installed on select unit branch lines to help determine potential leakages in flare header equipment. The indication uses a thermal probe installed in the flare line to detect increases or decreases in thermal activity in the line that could be indicative of an increase or decrease in flow. The indication may be used to show increases in flow as a result of a relief valve or block valve leaking. The quality of the data provided by the flow indication is still being evaluated by CRLLC Technical Service Department.

2.2 Lube Flare

2.2.1 Equipment and Controls

The Lube Flare was installed in August 2005 and is equipped with a John Zink designed flare tip. The original installation consisted of an elevated, steam-assisted, simple flare, with an ignition system and piping for the center steam, upper steam ring, pilot gas, and three ignition tubes. The steam supply piping is 2-inch diameter pipe rated up to 420 psig. Since its installation, there have been no modifications to the flare tip or tip replacements. The Lube Flare combusts vent gases from 5 control valves, 230 relief valves, 38 pump seals, 5 compressor vents, 14 sample stations, and other flows generated via maintenance or turnaround.

The elevated Lube Flare stack consists of a 108-inch diameter flare base riser tapering to 36-inch diameter outlet at the base of the flare tip. The total height of the flare stack assembly is 210 feet, and is self-supported. The Lube Flare header feeds into the Lube Flare Drum (14-F-10). The main Lube Flare header is fed by several subheaders equipped with knockout drums including the South Area Flare Drum (11-F-33), New PChem Hot Blowdown Drum (14-F-16), and Old PChem Hot Blowdown Drum (14-F-1).

The HSAI-Q5-C flare tip assembly was installed in August 2005 by John Zink as a part of the new flare installation. The flare tip has a diameter of 3 feet 7 inches and a length of 10 feet 1 inch. It includes a 2-inch center steam connection, which injects steam into the center of the vent gas flow just above the fluidic seal, and a 4-inch upper steam manifold connection, including an upper steam ring, steam risers, and steam spider tips. Also included is a 1-inch pilot gas manifold connection with 1-inch pilot connections and 1-inch ignition gas connections.

The Lube Flare header is outlined in the Simplified Schematic included in Appendix D. The flare header consists predominantly of four sections, including downstream flow from the old PChem Hot Blowdown Drum (14-F-1), the new PChem Hot Blowdown Drum (14-F-16), Propane Cavern Drums (16-F-1 and 16-F-2), and the South Area Flare Drum (11-F-33).

A series of monitoring instruments including vent gas, purge gas, and steam flow meters and a GC/TCD analyze the inputs to the flare header prior to the flare tip. The vent gas flow reading, along with information regarding composition from the GC/TCD, is used to signal the steam controller to adjust the amount of steam sent to the flare tip. Adjusting the amount of steam allows the flare to operate with optimal conditions to ensure proper combustion efficiency (i.e. greater than 98%). Additionally, recording flow rates and compositions allow MPC to evaluate the potential sources of flow more accurately and develop strategies for eliminating or reducing vent gas flow.

The Lube Flare services the major equipment in the #5 Vacuum and Crude Units (Units 1-037 and 1-041), Petrochemical Units (Cumene Unit 1-035, ADS Unit 1-028, Sulfolane Unit 1-027), Refining Units (Lower Gas Con Unit 2-002, Sat Gas Unit 2-030, LPCCR Unit 1-044, Guard Case Unit 1-004, LEP Unit 1-043) and storage areas (Butane Cavern 1-023, Propane Cavern 1-016).

2.2.2 Waste Gas Volumetric and Mass Flow Rates

The waste gas volumetric and mass flow rates can be determined for the flare systems by utilizing an ultrasonic flow meter and a Siemens MAXUM™ Edition II GC/TCD. The volumetric flow rate of the vent gas can be derived by an ultrasonic flow meter by determining the vent gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The mass flow rate of the vent gas can be derived by an ultrasonic flow meter which determines the mass flow rate of the vent gas and utilizes the calculated vent gas molecular weight. The GC/TCD allows for the calculation of the waste gas volumetric and mass flow rates by determining the composition of the vent gas.

Inert species within the vent gas (i.e., hydrogen, oxygen, nitrogen, carbon monoxide and carbon dioxide) can be excluded from the calculations. The average waste gas volumetric flow and mass flow rates for the Lube Petrochem Flare was determined for the 30-day period between July 1, 2013 and June 30, 2014 and are shown in the graphs in Figure 4 and Figure 5.

During the averaging period, turnarounds in the Guard Case Unit, ADS, Cumene, and LPCCR occurred contributing to higher flare flows during start-up and shutdown of these units. Procedures and projects are being evaluated to help limit the waste gas sent to the flare during these events. Since 2009, the Lube Flare has had five (5) ADS turnarounds, two (2) Guard Case turnarounds, two (2) LPCCR turnarounds, one (1) #5 Crude/Vac Unit turnaround, and one (1) Cumene Unit turnaround planned.

Figure 4: Lube Flare Waste Gas Volumetric Flow Rate (30 Day Rolling Average)

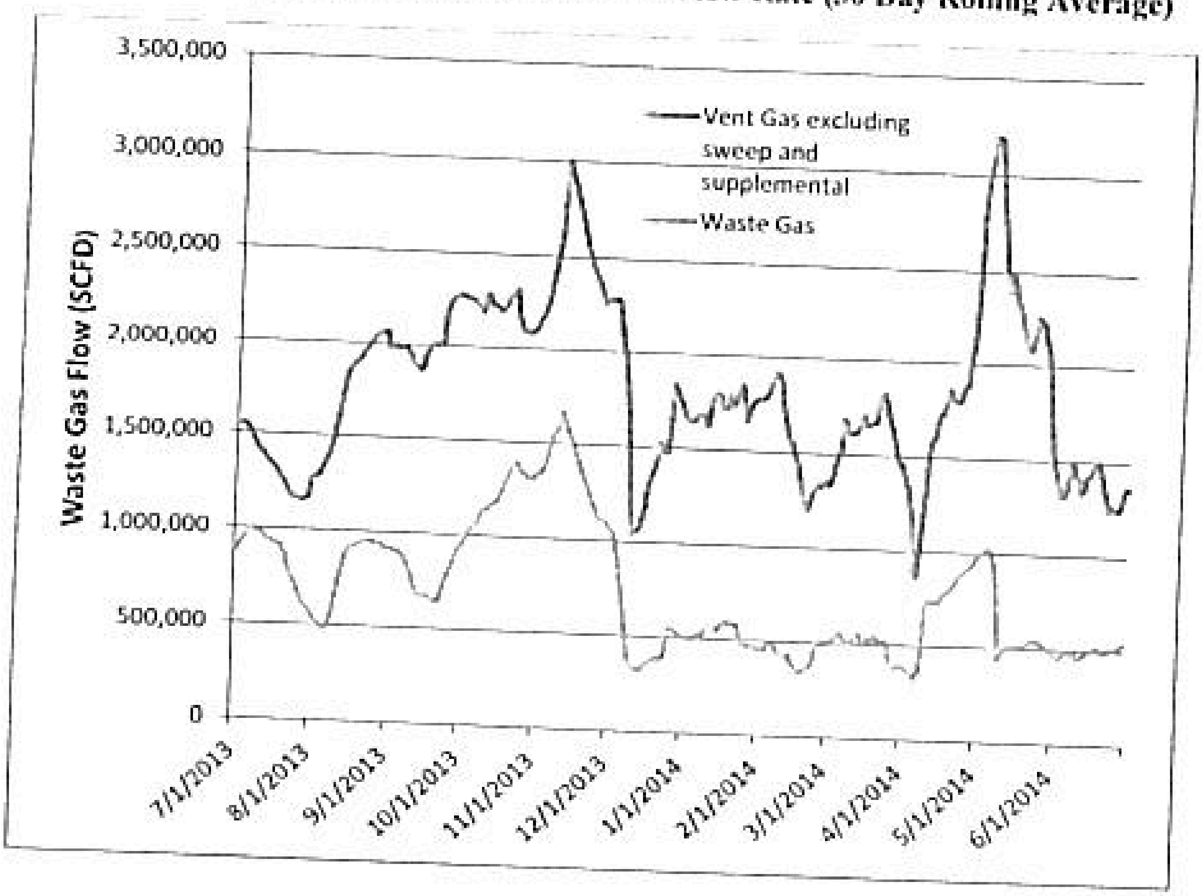
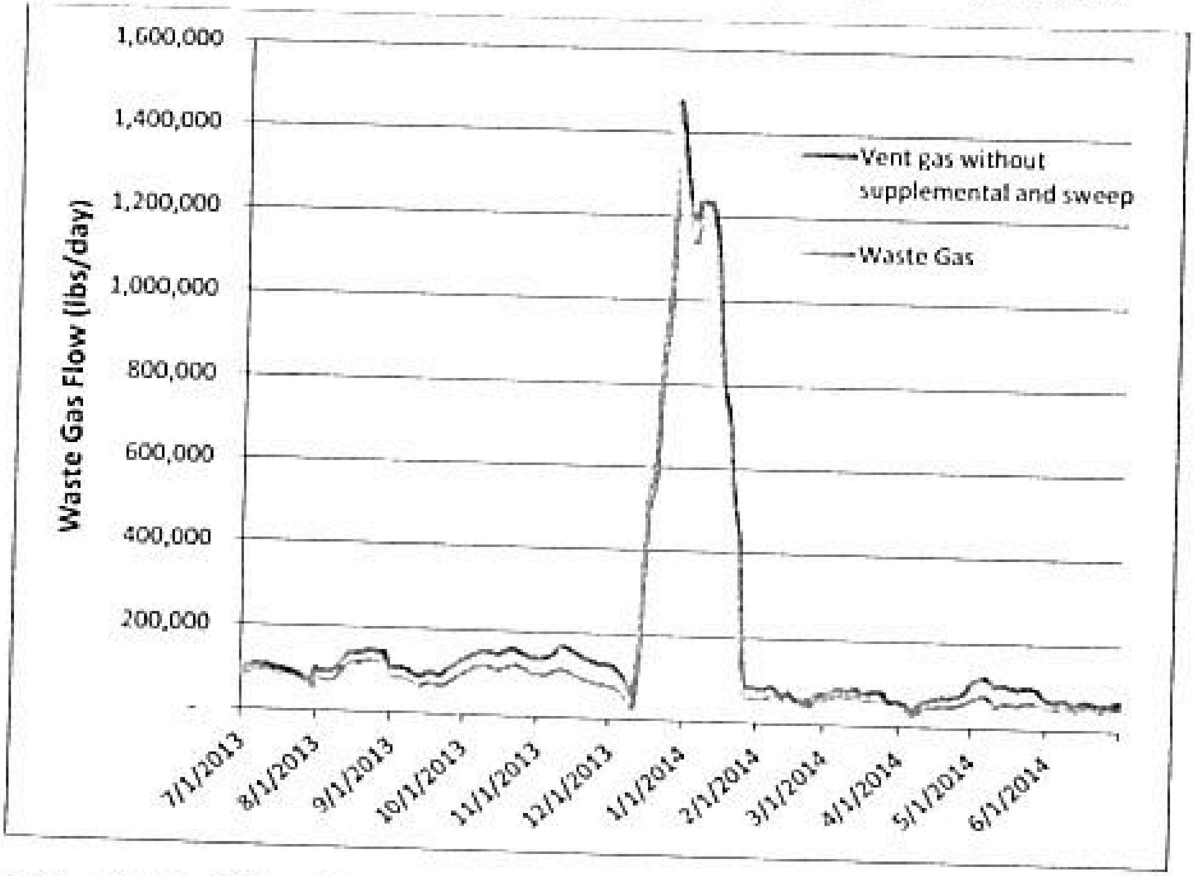


Figure 5: Lube Flare Waste Gas Mass Flow Rate (30 Day Rolling Average)



2.2.3 Baseload Waste Gas and Vent Gas Flow Rates

The baseload waste gas flow rate can be determined for the flare systems by utilizing an ultrasonic flow meter and GC/TCD. The flow meter is capable of calculating the volumetric flow rate of the vent gas by determining the vent gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC/TCD allows for the calculation of the waste gas volumetric flow rate by determining the composition of the vent gas Inert species within the vent gas (i.e., hydrogen, oxygen, nitrogen, carbon monoxide and carbon dioxide) can be excluded from the calculations. The waste gas flow rate reflects only the VOC content of the overall vent gas composition. The average baseload waste gas flow rate for the Lube Flare was determined to be 722,735 scfd and the average baseload vent gas flow rate was determined to be 1,986,521 scfd for the time between July 1, 2013 and June 30, 2014.

The following days data was excluded from the baseload calculations due to events associated with start-up, shutdown, and malfunction:

- 8/7/2013 LPCCR 44-PSV-54 relieved to the flare
- 8/9/2013 Cumeme RV lifted to the flare
- 8/15/2013 Cumene 35-PSV-121 relieved to the flare
- 9/23/2013 #5 Crude shutdown lead to high nitrogen sweeps going to flare
- 1/1/2014 #5 Crude 41-PSV-118 lifted to the flare
- 1/18/2014 #5 Crude venting from fractionator reflux drum
- 1/7/2014 Cold Weather Event
- 5/2/2014 Cumene 35-PSV-121 lifted to the flare
- 6/10/2014 – 6/13/2014 Refinery Wide Power Outage

2.2.4 Identification of Constituent Gases

Under normal, refinery operating conditions, gases vented to the flare from various refinery units have a typical composition. This gas composition varies between flares due to the difference in the functions of the units each flare services. Gas composition is determined through the use of a GC/TCD. This average composition can vary during flaring incidents related to startup, shutdown, maintenance and turnaround activities, as well as emergency flaring situations. Table 3 presents typical gas composition for the Lube Flare.

Table 3: Lube Flare Base Load Constituents

Component	Average Mole %
Hydrogen	36.4
Oxygen	0.03
Nitrogen	17.8
Methane	23.3
Carbon Monoxide	0.03
Carbon Dioxide	0.14
Ethane	4.9
Ethylene	2.2
Acetylene	$4.0*10^{-4}$
Propane	5.2
Propylene	1.1
i-Butane	1.5
n-Butane	2.5
i-Butene, Butene-1	0.08
trans-Butene-2	0.04
cis-Butene-2	0.03
1,3-Butadiene	$1.4*10^{-5}$
i-Pentane+	4.8
Hydrogen Sulfide	0.04

2.2.5 Waste Gas Mapping

Waste gas mapping of the Lube Flare header was conducted on September 20-22, 2011, through the use of isotropic tracing. Tracerco Diagnostics was on site to conduct a flow study by injecting a suitable radiotracer into the flare system and monitoring the movement of the tracer using radiation detectors mounted externally on the pipe. The data provided by the Tracerco Diagnostics study allowed for flow velocity and volumetric flow rates to be determined, as well as the identification of losses and leaks to the flare systems.

The map provided in Appendix D indicates the waste gas flows for the Lube Flare. Flows for each process unit branch line were estimated using the following hierarchy based on the best data available.

1. Tracerco Data- Not all flare headers had available taps for Tracerco injections to occur, however this data was determined to be the best available data for streams where it was available.
2. Tracerco Data distributed to process units based on unit component counts- If Tracerco data was available for a header that had multiple process units tied into it, the Tracerco data was flow was divided amongst those process units based on component counts.

3. Maximum known flow from a large vent gas contributor- If a control valve associated with a process unit had a flow meter associated with the valve, the maximum flow rate associated with this flow meter was used.
4. Flow indications- Flow indicators, which were brought on line for multiple unit headers in 2013 are used to indicate increases in flow. Engineering estimates based on flow indication changes and the header diameter were used if available.
5. AP-42 component uncontrolled leak rates- If none of the above data was available, flow rates were determined using AP-42 leak rates for components in light liquid and gas services. Sample station leak rates, relief valve leak rates to atmosphere, pump seal leak rates, compressor seal leak rates, and open ended line leak rates (used for estimating block valve emissions) were used.

It is of note that flows that are based off of the Tracerco study are only a snapshot in time, and that it is possible for the flows to change depending on process unit events.

2.2.6 Historic Emission Reductions

Provided in Table 4 below is a listing of preventive measures completed for the Lube Flare over the past 5 years. These reductions represent a good faith effort by MPC to reduce flaring prior to the requirements of the CD. Where possible, an estimate of the reduction is provided. Subsequent updates to this document will list all previously completed or implemented actions conducted prior to the revision date. All of the below projects reduce flaring because they reduce process unit upsets.

Table 4: Lube Flare Reductions Previously Realized

Year Installed or Implemented	Description
2012	A block valve connecting the reduction hydrogen and the flare had remained cracked as part of normal operations as a purge to the flare. This valve is no longer left cracked open.
2012	In the Sulfolane Unit, the dehexanizers that handle reformate from the two CCRs routinely vent to the flare. Optimization in the debutanizers in the CCRs have reduced the amount that these dehexanizers have been required to vent.
October 2013	Condensing system in the Cumene Unit to knock out additional hydrocarbon emissions and have them sent back to the slop system. This system has dropped the benzene emissions during these events to below 1 lbs.

2.2.7 Flare-Specific Planned Reductions

CRLLC is currently in the evaluation stages on multiple projects to reduce the overall waste gas prior to the June 30, 2016 waste gas limit deadline. The evaluations listed below will be complete by June 30, 2016:

- Reroute reduction hydrogen back to the reactor rather than send it to flare.

- Deinventory system to route emissions to sour fuel during planned outages to limit flaring.
- Reroute gases from dehexanizers in the Sulfolane to minimize flaring from these units.
- Reroute deinventory piping from propane and butane caverns to sour fuel.
- Install an additional stranded gas compressor to ensure streams listed above can be pressured to sour fuel.
- Installation of a flare gas recovery system.

Multiple projects are being evaluated to minimize high waste gas periods on the Lube Flare. The major flare plan being evaluated includes adding a flare gas recovery system to this flare for periods when large volumes of gases are being de-inventoried from the units.

Other projects being evaluated include rerouting the reduction hydrogen from the LPCCR back into the #1 Reactor and adding a new de-inventory system for the Cumene Unit. The LPCCR reduction gas, which consists mostly of hydrogen and light ends off of the reactor, will see an estimated total reduction of vent gas of 700,000 scfd vent gas and 100,000 scfd waste gas. This project is contingent on evaluating the potential damage caused by the addition of moisture to the reactor catalyst causing more rapid deactivity of the catalyst. A flare gas recovery system, which will have excess capacity for this gas, could also eliminate the need for this project.

In the Cumene unit where benzene can cause flaring emissions issues, a deinventory system is being designed to condense and knock out these emissions before they get to the flare. Table 5 presents a summary of planned waste gas reductions for the Lube Flare.

Table 5: Lube Flare Planned Reductions

Process Equipment	Total Vent Gas Flow (SCFH)	Total Waste Gas Flow (SCFH)	Reduction (SCFH)	Total Flow After Repair (SCFH)	Projects	Completion Date
Cumene Reactors	*	*	*	*	Constructing a system to condense additional waste gas	7/1/2016

All four flare systems have had flow indication installed on select unit branch lines to help determine potential leakages in flare header equipment. The indication uses a thermal probe installed in the flare line to detect increases or decreases in thermal activity in the line that could be indicative of an increase or decrease in flow. The indication may be used to show increases in flow as a result of a relief valve or block valve leaking. The quality of the data provided by the flow indication is still being evaluated by CRLLC Technical Service Department.

2.3 FCC Flare

2.3.1 Equipment and Controls

The FCC Flare was originally installed in June 1982. The original installation consisted of a "simple," self supported, steam assisted, elevated flare and an ignition system. All piping for the center steam, upper steam ring, pilot gas, and three ignition tubes was included. The steam supply piping was 6-inch diameter pipe rated for up to 450 pound steam. The most recent physical changes to the flare involved replacement of the flare tip in October 1992, by NAO, with the NFF-RC flare tip assembly. The flare tip has a diameter of 48 inches and a length of 12 feet, as well as a 3-inch center steam connection, which injects steam into the center of the vent gas flow just above the fluidic seal to prevent the potential of back burn in the tip during low gas flow conditions. A 6-inch external steam manifold provides steam to the upper nozzles which control smoke emissions and aid in proper combustion. A copy of the facility plot plan showing the location of the FCC Flare is included in Appendix E.

The elevated FCC Flare stack consists of a 7.1 feet diameter flare riser tapering to 48" near the top with a length of 228 feet. The total height of the flare stack assembly is 250 feet.

The FCC Flare header feeds into the FCC Unit Flare Drum (2-117-F-1), which is a horizontal vessel with an internal diameter of 12 feet and length of 50 feet. The FCC Flare header is outlined in the Simplified Schematic included as Figure 4. The flare header system for the FCC flare collects and delivers vent gases from the FCC Unit (Unit 2-109), Upper Gas Con Unit (Unit 2-110), C_3/C_4 Treating Units (Units 2-113), Gasoline Treating Unit (Unit 2-114), and the Heat Recovery Units (Unit 2-116). Gases which are vented from these areas, either from system over-pressurization caused by a malfunction or, flow into the FCC Flare Knockout Drum (2-117-F-1) and ultimately to the flare tip. The FCC Flare combusts vent gases from approximately 38 relief valves, 1 pressure control valve, 4 pump seals, 3 sample stations, 1 compressor vent, 15 block valves, 1 fuel gas sweep, and other flows generated via maintenance or turnaround.

A series of monitoring instruments including vent gas, purge gas, and steam flow meters and a Siemens MAXUM™ Edition II GC/TCD analyze the inputs to the flare header prior to the flare tip. The vent gas flow reading, along with information regarding composition from the GC/TCD, is used to signal the steam controller to adjust the amount of steam sent to the flare tip. Adjusting the amount of steam allows the flare to operate with optimal conditions to ensure proper combustion efficiency (i.e. greater than 98%). Additionally, recording flow rates and compositions allow MPC to evaluate the potential sources of flow more accurately to develop strategies for eliminating or reducing vent gas flow.

2.3.2 Waste Gas Volumetric and Mass Flow Rates

The waste gas volumetric and mass flow rates can be determined for the flare systems by using an ultrasonic flow meter and GC/TCD. The volumetric flow rate of the vent gas can be derived by an ultrasonic flow meter by determining the vent gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The mass flow rate of the vent gas can be derived by an ultrasonic flow meter by determining the mass flow rate of the vent gas and the calculated vent gas molecular weight. The GC/TCD allows for the calculation of the waste gas volumetric and mass flow rates by determining the composition of the vent gas. Inert species within the vent gas (hydrogen, oxygen, nitrogen, carbon monoxide and carbon dioxide) can be excluded from the calculations. Figures 6 and 7 presents the average waste gas volumetric flow and mass flow rates for the FCC Flare was determined for the 365-day period between July 1, 2013 and June 30, 2014.

During the averaging period, turnarounds in the FCC and the Upper Gas Con. Unit occurred contributing to higher flare flows during start-up and shutdown of these units. Procedures and projects are being evaluated to help limit the waste gas sent to the flare during these events. Since 2009, the FCC Flare has just had these unit turnaround planned.

Figure 6: FCC Flare Waste Gas Volumetric Flow Rate (30 Day Rolling Average)

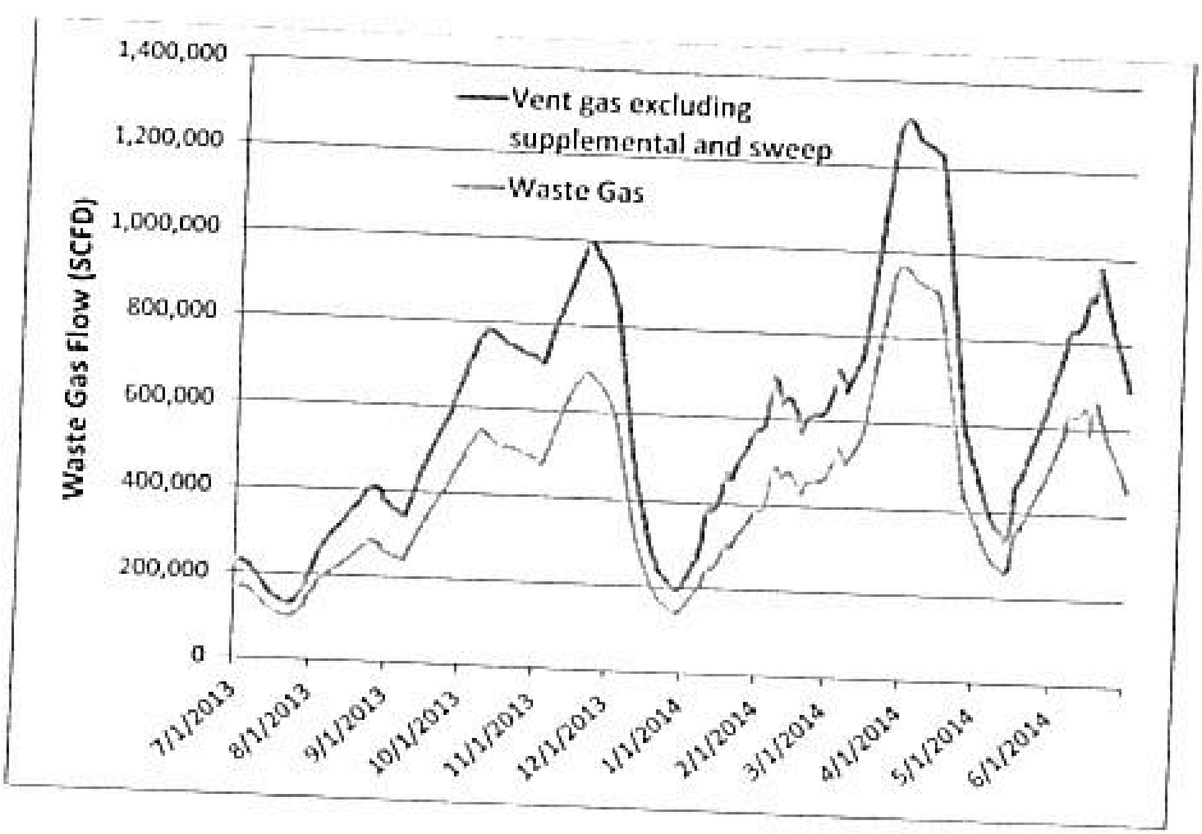
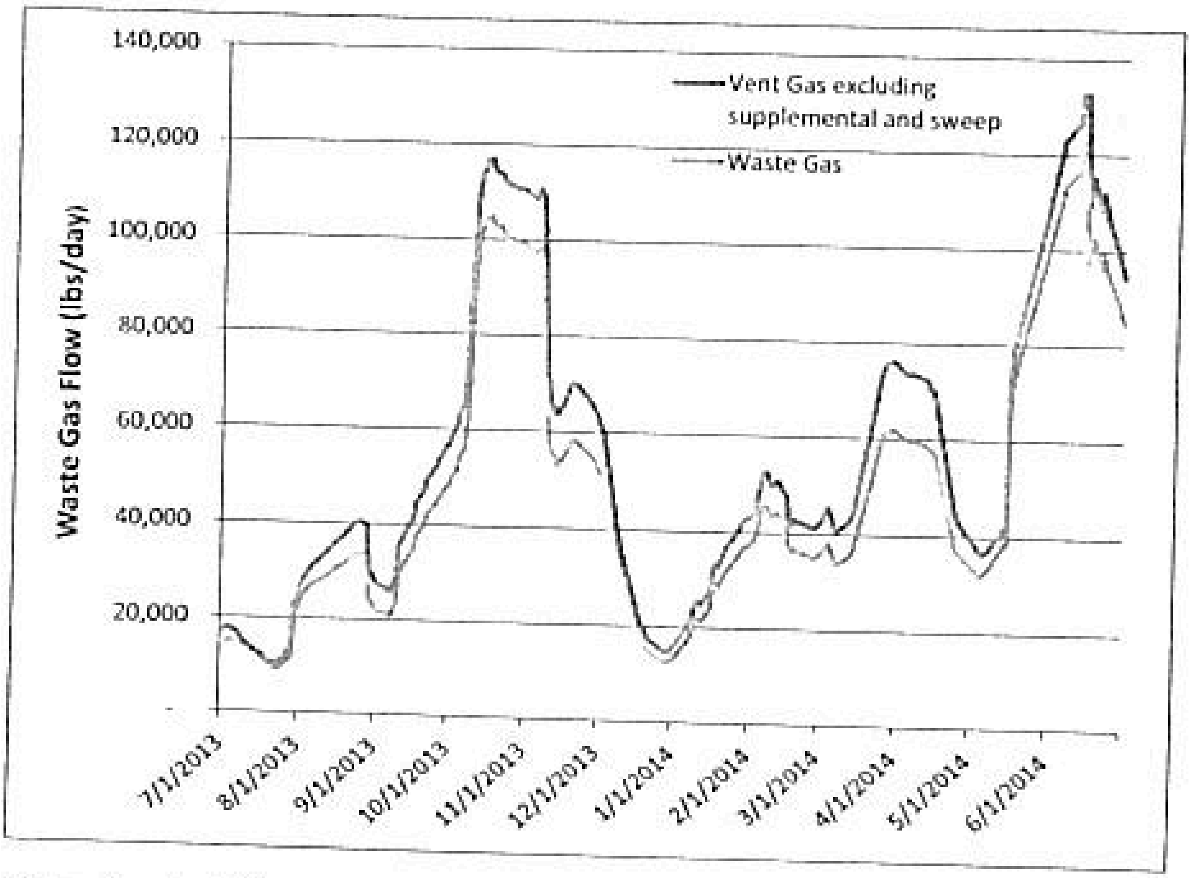


Figure 7: FCC Flare Waste Gas Mass Flow Rate (30 Day Rolling Average)



2.3.3 Baseload Waste Gas and Vent Gas Flow Rates

The baseload waste gas flow rate can be determined for the flare systems by utilizing an ultrasonic flow meter and GC/TCD. The flow meter is capable of calculating the volumetric flow rate of the vent gas by determining the vent gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC/TCD allows for the calculation of the waste gas volumetric flow rate by determining the composition of the vent gas. Inert species within the vent gas (hydrogen, oxygen, nitrogen, carbon monoxide and carbon dioxide) can be excluded from the calculations. The waste gas flow rate reflects only the VOC content of the overall vent gas composition. The average baseload waste gas flow rate for the FCC Flare was determined to be 407,349 scfd and the average baseload vent gas flow rate was determined to be 947,563 scfd for the time between July 1, 2012 through June 30, 2013.

The following days data was excluded from the baseload calculations due to events associated with start-up, shutdown, and malfunction:

- 1/7/2014 Extreme Cold Weather Event
- 1/17/2014 FCC Start Up

- 5/14/2014 – 5/16/2014Wet Gas Compressor shut down
- 6/10/2014 6/13/2014 Refinery Wide Power Outage
- 6/15/2014 High flow due to low combustion zone net heating value false readings

2.4.4 Identification of Constituent Gases

Under normal refinery operating conditions, gases vented to the flare from the various refinery units have a typical composition. This gas composition varies between flares due to the difference in the functions of the units each flare services. Gas composition is determined through the use of a GC/TCD. This average composition can vary during flaring incidents related to startup, shutdown, maintenance and turnaround activities, as well as emergency flaring situations. Table 6 lists typical baseload chemical constituents for the FCC Flare.

Table 6: FCC Flare Base Load Constituents

Component	Average Mole %
Hydrogen	12.7
Oxygen	0.18
Nitrogen	15.0
Methane	35.4
Carbon Monoxide	0.38
Carbon Dioxide	0.74
Ethane	13.0
Ethylene	17.0
Acetylene	$3.8*10^{-3}$
Propane	1.1
Propylene	2.8
i-Butane	0.79
n-Butane	0.11
i-Butene, Butene-1	0.17
trans-Butene-2	0.07
cis-Butene-2	0.04
1,3-Butadiene	$8.0*10^{-4}$
i-Pentane+	0.56
Hydrogen Sulfide	$5.5*10^{-3}$

2.3.5 Waste Gas Mapping

Waste gas mapping of the FCC Flare was conducted on December 16-17, 2011 through the use of isotropic tracing. Tracerco Diagnostics was on site to conduct a flow study by injecting a suitable radiotracer into the flare system and monitoring the movement of the tracer using radiation detectors mounted externally on the pipe. The data provided by the Tracerco Diagnostics study allowed for flow velocity and volumetric flow rates to be determined, as well as the identification of losses and leaks into the flare systems.

The map provided in Appendix E indicates the waste gas flows for the FCC Flare. Flows for each process unit branch line were estimated using the following hierarchy based on the best data available.

1. Tracerco Data- Not all flare headers had available taps for Tracerco injections to occur, however this data was determined to be the best available data for streams where it was available.
2. Tracerco Data distributed to process units based on unit component counts- If Tracerco data was available for a header that had multiple process units tied into it, the Tracerco data was flow was divided amongst those process units based on component counts.
3. Maximum known flow from a large vent gas contributor- If a control valve associated with a process unit had a flow meter associated with the valve, the maximum flow rate associated with this flow meter was used.
4. Flow indications- Flow indicators, which were brought on line for multiple unit headers in 2013 are used to indicate increases in flow. Engineering estimates based on flow indication changes and the header diameter were used if available.
5. AP-42 component uncontrolled leak rates- If none of the above data was available, flow rates were determined using AP-42 leak rates for components in light liquid and gas services. Sample station leak rates, relief valve leak rates to atmosphere, pump seal leak rates, compressor seal leak rates, and open ended line leak rates (used for estimating block valve emissions) were used.

It is of note that flows that are based off of the Tracerco study are only a snapshot in time, and that it is possible for the flows to change depending on process unit events.

2.3.6 Historic Emission Reductions

Provided below is a listing of preventive measures completed over the past 5 years. These reductions represent a good faith effort by MPC to reduce flaring prior to the requirements of the CD. Where possible, an estimate of the reduction is provided. Subsequent updates to this document will list all previously completed or implemented actions conducted prior to the revision date.

Table 7: FCC Flare Reductions Previously Realized

Year Installed or Implemented	Description	Reason for Reduction
2012	Fuel gas purge from FCC Fuel Gas Drum (2-116-F-34) was equipped with electronic measuring device for accurate flow measurement	Waste Gas Calculation Reduction

2.3.7 Flare-Specific Planned Reductions

The refinery is in the process of evaluating the installation of a piping system to help elevate the load on the flare during planned unit outages. The evaluation of these plans will be complete by June 30, 2016.

All four flare systems have had flow indication installed on select unit branch lines to help determine potential leakages in flare header equipment. The indication uses a thermal probe installed in the flare line to detect increases or decreases in thermal activity in the line that could be indicative of an increase or decrease in flow. The indication may be used to show increases in flow as a result of a relief valve or block valve leaking. The quality of the data provided by the flow indication is still being evaluated by CRLLC Technical Service Department.

2.4 Alky Flare

2.4.1 Equipment and Controls

CRLLC's Alkylation Unit Flare (Alky Flare) was installed in February 1979 and equipped with a John Zink design tip. The original installation consisted of an elevated, steam-assisted, flare, and an ignition system. All piping for the upper steam ring, pilot gas, and three ignition tubes was included. The steam supply piping is 6-inch diameter pipe rated for up to 450 psig steam. The most recent physical changes to the flare involved replacement of the flare tip in March 1989, by John Zink, with the STF-S-36 flare tip assembly.

The elevated Alky Flare stack consists of a 6-feet diameter lower stack, a 4-feet diameter middle stack, and a 3-feet diameter upper stack and flare tip riser with a length of 238 feet. The total height of the flare stack assembly is 250 feet and 7 inches, and is self-supported.

The STF-S-36 flare tip assembly was installed in March 1989 by John Zink. The flare tip has a diameter of 36 inches. It includes a 6-inch upper steam manifold connection, including an upper steam ring, steam risers, and steam spider tips. The 6-inch steam riser splits into 39 steam jets. Also included is a 2-inch pilot gas manifold connection with three 1-inch pilot and ignition gas connections.

The Alky Flare header feeds into the Alky KO Drum (2-11-F-34), which is a horizontal vessel with an internal diameter of 12 feet, and a tangent-to-tangent length of 44 feet. Additional knockout drums include the Hot Blowdown Drum (2-11-F-18), which feeds into the Alky KO Drum and is a horizontal vessel that has an internal diameter of 12 feet and a tangent-to-tangent length of 56 feet and a second Flare KO Drum (2-11-F-36) downstream of the Alky Flare KO Drum, which is a vertical vessel with an internal diameter of 4 feet and a tangent to tangent length of 5 feet.

The Alky Flare header is outlined in the Simplified Schematic included in attachment F. The flare header system for the Alky Flare collects and delivers vent gases from the Alky Unit, Saturate Gas Unit, portions of the Lower Gas Concentration Unit, #3 Crude Unit, Blender, and several LPG spheres. Gases that are vented from these areas, either from system over-pressurization caused by malfunction or any other reason, flow into various knock out drums. Most of the flare streams flow directly to the Alky KO Drum; however, the #3 Crude Unit first flows into the Hot Blowdown Drum (2-11-F-18) and then to the Alky KO Drum and the Blender header is downstream of the Alky KO Drum so liquids from this stream flow into a KO Drum and are then rerouted back to the Alky KO Drum and then ultimately to the flare tip. Prior to the Alky KO Drum, any flared streams in the Alky that may contain hydrofluoric acid are first neutralized with potassium hydroxide caustic in the acid relief neutralizer. The Alky Flare combusts vent gases from approximately 149 relief valves, 13 sample stations, 93 block valves, 20 pump seals, 4 control valves, 5 purges (4 nitrogen, 1 fuel gas), and 1 compressor seal, along with other flows generated via maintenance or turnaround events.

A series of monitoring instruments including vent gas, purge gas, and steam flow meters and a Siemens MAXUM™ Edition II GC/TCD analyze the inputs to the flare header prior to the flare tip. The vent gas flow reading, along with information regarding composition from the GC/TCD, is used to signal the steam controller to adjust the amount of steam sent to the flare tip. Adjusting the amount of steam allows the flare to operate with optimal conditions to ensure proper combustion efficiency (i.e. greater than 98%). Additionally, recording flow rates and compositions allow MPC to evaluate the potential sources of flow more accurately and develop strategies for eliminating or reducing vent gas flow.

2.4.2 Waste Gas Volumetric and Mass Flow Rates

The waste gas volumetric and mass flow rates can be determined for the flare systems by using an ultrasonic flow meter and GC/TCD. The volumetric flow rate of the vent gas can be derived by an ultrasonic flow meter by determining the vent gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The mass flow rate of the vent gas can be derived by an ultrasonic flow meter by determining the mass flow rate of the vent gas and the calculated vent gas molecular weight. The GC/TCD allows for the calculation of the waste gas volumetric and mass flow rates by determining the composition of the vent gas. Inert species within the vent gas (i.e., hydrogen, oxygen, nitrogen, carbon monoxide and carbon dioxide) can be excluded from the calculations. Figures 8 and 9 show the average waste gas volumetric flow and mass flow rates for the Alky Flare was determined for the 365-day period between July 1, 2013 and June 30, 2014.

During the averaging period, turnarounds in the Alky and the Lower Gas Con Units occurred contributing to higher flare flows during start-up and shutdown of these units. Procedures and projects are being evaluated to help limit the waste gas sent to the flare during these events. Since 2009, the FCC Flare has had the Alky Unit involved in three (3) planned turnarounds and one (1) #3 Crude/Vac Unit planned turnaround.

Figure 8: Alky Flare Waste Gas Volumetric Flow Rate (30 Day Rolling Average)

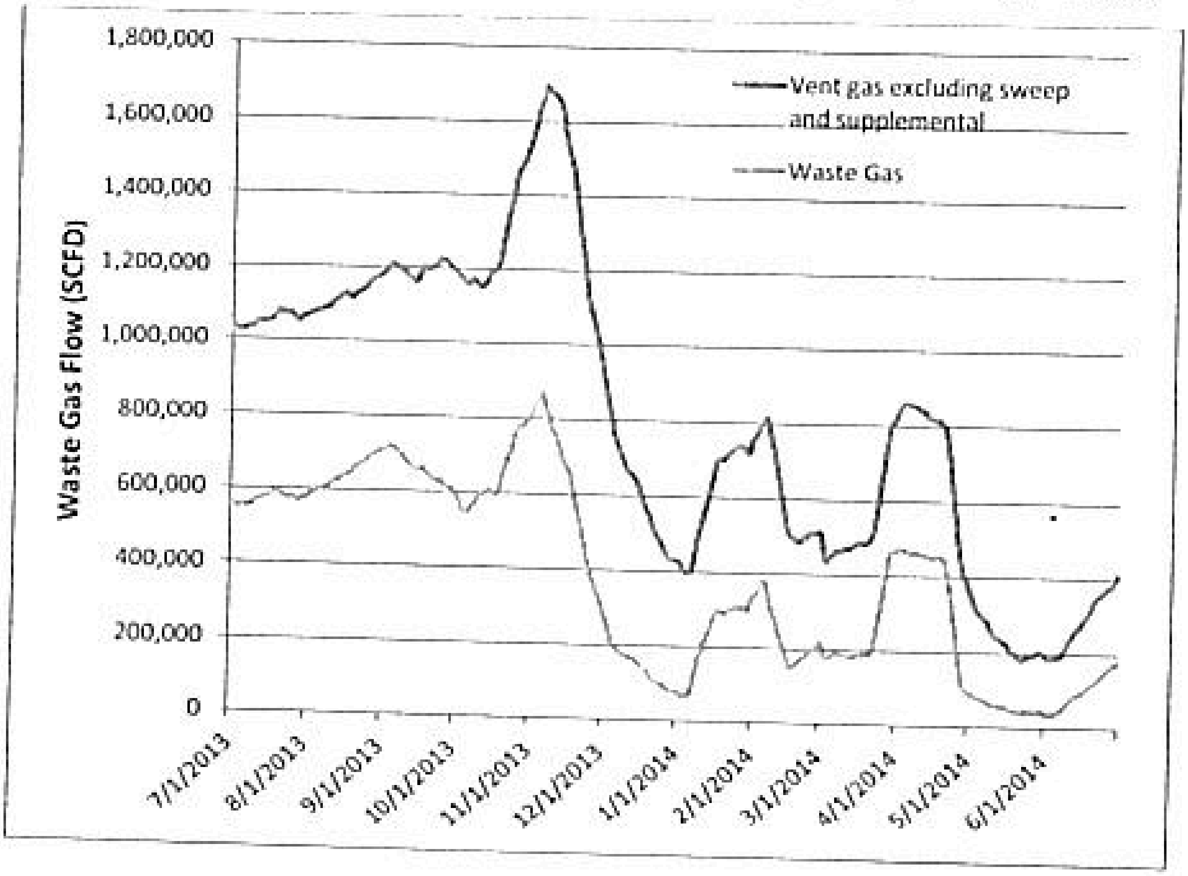
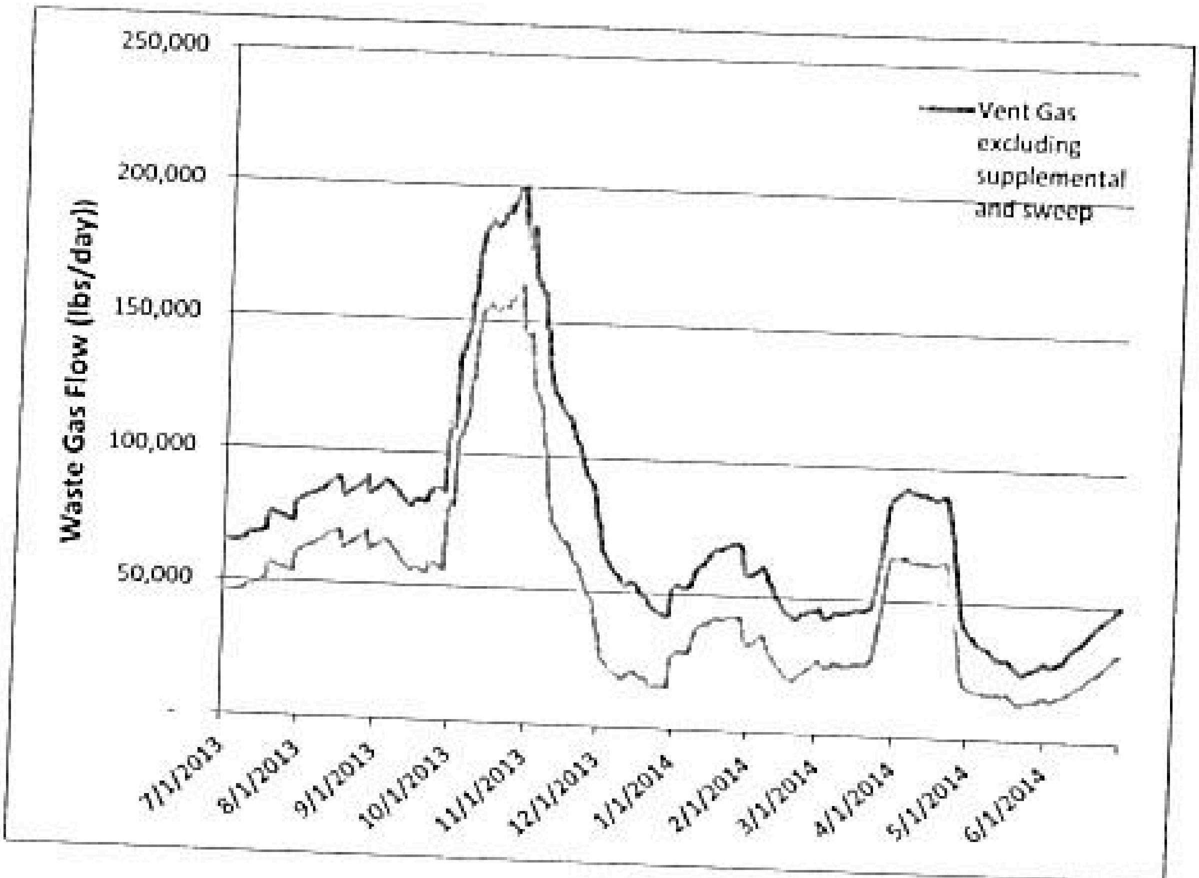


Figure 9: Alky Flare Waste Gas Mass Flow Rate (30 Day Rolling Average)



2.4.3 Baseload Waste Gas and Vent Gas Flow Rates

The baseload waste gas flow rate can be determined for the flare systems by utilizing an ultrasonic flow meter and GC/TCD. The flow meter is capable of calculating the volumetric flow rate of the vent gas by determining the vent gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC/TCD allows for the calculation of the waste gas volumetric flow rate by determining the composition of the vent gas. Inert species within the vent gas (i.e., hydrogen, oxygen, nitrogen, carbon monoxide and carbon dioxide) can be excluded from the calculations. The waste gas flow rate reflects only the VOC content of the overall vent gas composition. The average baseload waste gas flow rate for the Alky Flare was determined to be 382,457 scfd and the average baseload vent gas flow rate was determined to be 1,467,360 scfd for the time between July 1, 2013 through June 30, 2014.

The following days data was excluded from the baseload calculations due to events associated with start-up, shutdown, and malfunction:

- 9/19/2013 Hydrog bleeder valve open caused High H_2S in going to Alky Flare
- 9/21/2013 Hydrog unit shutdown

- 9/23/2013 Stranded Gas compressor shutdown
- 10/14/2013 Depropanizer shutdown
- 1/7/2014 Extreme Cold Weather Event
- 4/17/2014 Depropanizer upset caused SO_2 Exceedence
- 6/10/2014 – 6/13/2014 Refinery-Wide Power Outage

2.4.4 Identification of Constituent Gases

Under normal, refinery operating conditions, gases vented to the flare from various refinery units have a typical chemical composition. This gas composition varies between flares due to the difference in the functions of the units each flare services. Gas composition is determined through the use of a GC/TCD. This average composition can vary during flaring incidents related to startup, shutdown, maintenance and turnaround activities, as well as emergency flaring situations. Table 8 presents typical gas compositional for the Alky Flare.

Table 8: Alky Flare Base Load Constituents

Component	Average Mole %
Hydrogen	18.5
Oxygen	0.6
Nitrogen	23.5
Methane	36.6
Carbon Monoxide	0.02
Carbon Dioxide	0.2
Ethane	6.2
Ethylene	2.1
Acetylene	$7.9*10^{-3}$
Propane	5.7
Propylene	0.5
i-Butane	3.3
n-Butane	1.1
i-Butene, Butene-1	0.1
trans-Butene-2	0.09
cis-Butene-2	0.06
1,3-Butadiene	$7.3*10^{-4}$
i-Pentane+	1.48
Hydrogen Sulfide	$7.1*10^{-3}$

2.4.5 Waste Gas Mapping

Waste gas mapping for the Alky Flare header was conducted on September 20-22, 2011 through the use of isotropic tracing. Tracerco Diagnostics was on site to conduct a flow study by injecting a suitable radiotracer into the flare system and monitoring the movement of the tracer using radiation detectors mounted externally on the pipe work. The data provided by the Tracerco Diagnostics study allowed for flow velocity and volumetric flow rates to be determined, as well as the identification of loses and leaks to the flare systems.

The map provided in Appendix F indicates the waste gas flows for the Alky Flare. Flows for each process unit branch line were estimated using the following hierarchy based on the best data available.

1. Tracerco Data- Not all flare headers had available taps for Tracerco injections to occur, however this data was determined to be the best available data for streams where it was available.
2. Tracerco Data distributed to process units based on unit component counts- If Tracerco data was available for a header that had multiple process units tied into it, the Tracerco data was flow was divided amongst those process units based on component counts.
3. Maximum known flow from a large vent gas contributor- If a control valve associated with a process unit had a flow meter associated with the valve, the maximum flow rate associated with this flow meter was used.
4. Flow indications- Flow indicators, which were brought on line for multiple unit headers in 2013 are used to indicate increases in flow. Engineering estimates based on flow indication changes and the header diameter were used if available.
5. AP-42 component uncontrolled leak rates- If none of the above data was available, flow rates were determined using AP-42 leak rates for components in light liquid and gas services. Sample station leak rates, relief valve leak rates to atmosphere, pump seal leak rates, compressor seal leak rates, and open ended line leak rates (used for estimating block valve emissions) were used.

It is of note that flows that are based off of the Tracerco study are only a snapshot in time, and that it is possible for the flows to change depending on process unit events.

2.4.6 Historic Emission Reductions

Provided in Table 9 below is a listing of preventive measures completed for the Alky Flare over the past 5 years. These reductions represent a good faith effort by MPC to reduce flaring prior to the requirements of the CD. Where possible, an estimate of the reduction is provided. Subsequent updates to this document will list all previously completed or implemented actions conducted prior to the revision date.

Table 9: Alky Flare Reductions Previously Realized

Year Installed or Implemented	Description	Reason for Reduction
2012	Fuel gas purge from South Area fuel drum was equipped with electronic measuring device for accurate flow measurement	Waste Gas Calculation Reduction

2.4.7 Flare-Specific Planned Reductions

Multiple projects are being evaluated for the Alky Flare for use during equipment maintenance. All of these projects are still in the evaluation stage and have not yet been finalized.

CRLLC is currently working on developing a plan to handle waste gas during a planned shutdown of equipment on the Alky Flare. CRLLC is evaluating the addition of a flare gas recovery system for the Alky Flare that would be utilized mostly during unit shutdowns. This can be done by either building a separate compressor system or tying into the potential compressor at the NNA Flare that is also being evaluated. If this is not done, then CRLLC will install a piping system to direct the gases to the Stranded Gas Compressor (2-30-GC-10).

CRLLC is evaluating additional systems to handle gases when the Debutanizer Tower and Hot Oil Heaters either malfunction or require maintenance. These gases have historically gone to the flare, and cannot be sent to storage because of the potential to have HF acid associated with their discharge.

All four flare systems have had flow indication installed on select unit branch lines to help determine potential leakages in flare header equipment. The indication uses a thermal probe installed in the flare line to detect increases or decreases in thermal activity in the line that could be indicative of an increase or decrease in flow. The indication may be used to show increases in flow as a result of a relief valve or block valve leaking. The quality of the data provided by the flow indication is still being evaluated by CRLLC Technical Service Department.

3.0 Refinery-Wide Flaring Prevention Measures

3.1 Administrative Policies and Procedures

It is the policy of MPC to assure that process vents are designed to send vent gases to a refinery flare to safely burn vent gases and reduce the potential for explosion, fire, or other safety hazard. Flares are to be used only to the extent that they are required to protect workers and the nearby community and to ensure reliable operation of process equipment, such as during startup, shutdown, malfunction, and/or major maintenance. All other flaring is not permitted per this policy.

As part of the WGMP activities, root cause analyses must be conducted for each flaring incident with a waste gas flow rate of over 500,000 scfd, VOC emission of greater than 500 pounds, and/or sulfur dioxide (SO_2) emission of greater than or equal to 500 pounds. The root cause analyses (RCA) should identify the following information:

- Date and time of the flaring incident;
- Volume of waste gas;
- Estimate of the quantity of VOCs and SO_2 with calculations;
- Steps taken to eliminate the source;
- Cause(s) of the incident; and
- Corrective measures proposed to prevent the incident from recurring.

This analysis must be incorporated into the planned reductions discussed in this report and reported to the USEPA within 45 days following the incident. Typical recommendations for preventive measures include revisions to maintenance schedules or practices, revisions to operational procedures, changes to process equipment configuration or type, and/or revisions to project planning processes. See Appendix G for the procedure MPC will follow for these investigations.

3.2 Flares Removed from Service

As required by paragraph 29 of the Consent Decree, CRLLC removed the Pitch Flare (1-14-FS-1) from service on December 19, 2012 by physically isolating the flare from the relief gas system.

3.3 Equipment and Hardware

CRLLC has installed automated steam control equipment to monitor flow to the flare systems and adjust steam rates to optimize combustion. The steam control systems use flare gas data collected from various instruments to determine the steam demand, and thus control the amount of steam sent to the flare via automated steam valves.

3.3.1 Vent Gas Flow Rate, Temperature and Molecular Weight

An ultrasonic flow meter measures the flow rate, temperature and molecular weight of vent gas sent to the flare. This flow meter, however, cannot distinguish between two compounds with the same molecular weight, such as propane and carbon dioxide (44 grams/mole). Therefore, the vent gas molecular weight cannot be independently used in steam control logic. A GC/TCD is used in conjunction to determine the vent gas composition and provide a more accurate indication of hydrocarbon levels in the vent gas.

3.3.2 Vent Gas Composition

The vent gas will be monitored by a GC/TCD to determine vent gas composition and heat content (BTU/scf). This monitoring system will provide a data point approximately once every 10 minutes which is used to verify molecular weight readings from the flow meter. A sulfur analyzer in the GC/TCD is also capable of determining the amount of hydrogen sulfide for vent gas sulfur content purposes.

3.3.3 Volumetric Flow – Vent Gas

Ultrasonic flow meters installed in the flare system provide the flow velocity of the vent gas on a continuous basis. The volumetric flow of the vent gas can be derived from the vent gas velocity by incorporating the cross sectional area of the pipe in which the flow meter is installed. The flow meter directly provides the volumetric flow rate so that no external calculations are required.

3.3.4 Mass Flow – Steam and Vent Gas

Ultrasonic flow meters are also used to determine the mass flow rates of the steam and vent gas on a continuous basis. Using the molecular weight and molar flow rate of the vent gas, the mass flow rate can be calculated. The flow meter directly outputs the mass flow rate with no need for external calculations. Nitrogen content of the vent gas, however, introduces error into the molecular weight calculations. The GC/TCD can provide nitrogen content data approximately every 10 minutes to allow for a more accurate determination of the vent gas molecular weight. However, the flow meter still calculates the molecular weight of the gas as a whole, including nitrogen, even with the nitrogen compensation data points.

3.4 Major Maintenance/Turnaround/Turnaround NOx Emissions

During maintenance on equipment and processes it is often necessary to purge equipment of all vapors for safety and environmental reasons. For example, this purging is directed to the relief gas system leading to flaring. MPC attempts to limit maintenance requiring equipment purges to flare; however, this can be unavoidable in order to provide for internal inspections and equipment cleanout/replacement. Included in Sections 2.1.2, 2.2.2, 2.3.2, and 2.4.2 are lists of flaring events caused by maintenance activities over the last five (5) years. A discussion of the feasibility of performing these activities without flaring is provided below. For the purpose of this section, maintenance activities are scheduled process unit turnarounds, as well as, near-term shutdowns planned for other maintenance activities.

It is the goal of all planned maintenance activities to limit the amount of hydrocarbon gases sent to the flare during process equipment purging. When possible, pressurized gases in process equipment are sent to another process unit or to the refinery fuel gas system, as opposed to the relief gas system. Liquids can be also be pumped to storage or other process units prior to purging to the relief gas system. However, although most material can be removed, residual vapors and liquids may remain. The relief gas system is a low-pressure system to safely vent these residual materials.

Purging of process equipment is accomplished using an inert gas (e.g., nitrogen) or steam depending on the properties of the material to be purged. Steam is often more effective for heavier hydrocarbons by increasing the volatility via the increase in temperature. However, it also may lead to concerns regarding equipment corrosion from the condensation of water in the equipment. The determination of what purge method to use can reduce flaring by ensuring the most effective means are employed and the load burden on the flare system is reduced.

In MPC's effort to continue improving process reliability, mechanical integrity and reliability assessments are conducted prior to major maintenance and turnarounds to ensure that the best technology is used. Constant improvement in purging materials and technology leads to fewer required turnarounds and a reduction in associated flaring events. MPC continues to review mechanical integrity prior to turnaround activities and expects to continually increase the time between these events.

CRLLC's flares are designed and installed to prevent uncontrolled releases of flammable or explosive mixtures of petroleum hydrocarbon gases containing VOC, H_2S, and HAP. The flares protect air quality and simultaneously perform an essential safety function. The waste gases routed to the flare from the refining process units do not contain NOx. However, in the process of safely destroying these waste gases to meet applicable requirements of NSPS, NESHAP, and SIP regulations, collateral NOx emissions are generated. NOx emissions from the refinery's flares are expected to include a contribution only from thermal NOx formation because negligible quantities of nitrogenous compounds are present in the flared gas. During turnaround activities, a NOx emissions limit of 5,010 lbs/day limit will be used.

3.5 Flare Gas Recovery

CRLLC is not equipped with flare gas recovery compressors on any of its four process flares, however it did install a compressor in 2008 to handle various streams that had high H_2S concentrations. This compressor, known as the Stranded Gas Compressor (2-30-GC-10), has a design capacity of 7.27 MMSCFD.

3.6 Recurrent Equipment Failures

Recurrent failures of air pollution control equipment, process equipment, or a process to operate in a normal or usual manner that can cause flaring events, include any event occurring more than two times over a five year period as a result of the same cause. These events will be identified through RCAs and tracked by the refinery beginning on the creation date of this document.

The refinery has established a thorough preventive maintenance program which includes the inspection and testing of critical process components. This program is consistent with recognized industry standards. The objective of the program is to maintain the reliability of equipment so that failures and other types of process upsets are eliminated. While refinery flare systems were designed to safely handle such emergency events, when upsets do occur, investigations are conducted to determine the root cause(s) and identify preventive/corrective actions.

All instances of recurrent failures, occurring after the creation date of this document through the most recent revision period, will be summarized below. Included in the discussion will be the dates, root cause, and actions taken to address the failure.

Reoccurring Event	Cause	Number of Occurrences
Stranded Gas Drum (2-30-F-87) open to flare	Shutdown of Stranded Gas Compressor	4
Venting SDA butane to the flare	Shutdown of SDA Compressor (2-31-GC-17)	4
Amine Scrubber (113-D-1) PSV-1 relieving to flare	Flooding issues with Amine Scrubber	2
#5 Crude Overhead open to flare	Crude Unit upsets	3
LEP Dehexanizer Overhead open to flare	Unit upset	3
FCC Main Column Overhead open to flare	Unit upset/ Loss of Wet Gas Compressor (2-110-GC-1)	13

3.7 Other Potential Flaring Events

For events with a potential to cause flaring, planning is conducted to determine ways to avoid flaring. This includes major maintenance and turnarounds, as well as new installations/upgrades. Project committees are tasked with developing strategies to limit the amount of flaring to that which is absolutely necessary. Additionally, when there is a flaring event, processes are in place to evaluate the extent of the event and determine the cause. Using root cause analyses, CRLLC will evaluate the flaring event and use the data collected to plan for better procedures and processes or more appropriate equipment. Lastly, potential preventive measures are selected based on the planning and evaluations and will be incorporated into subsequent revisions of this document as implemented at CRLLC.

Appendix A

Consent Decree Reference Table

Consent Decree Reference Table

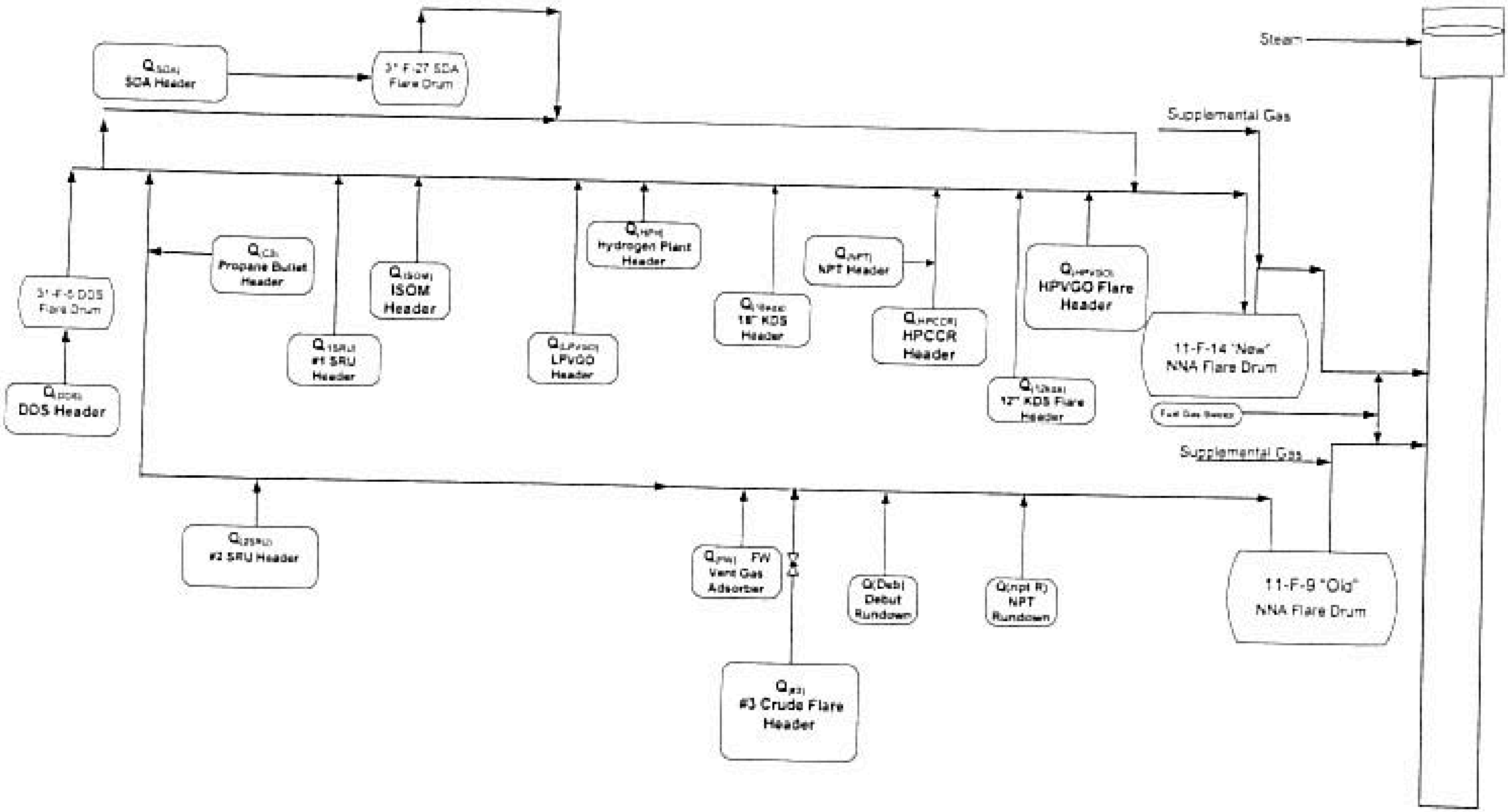
Appendix B

Plan Revision History Log

Revision	Date	Author	Description
0	7/29/2013	J. Fournier	Initial Waste Gas Minimization Plan
1	7/29/2014	B. Bazemore	First Update to Waste Gas Minimization Plan

Appendix C

NNA Flare Waste Gas Flow


Steam
Supplemental Gas
Q(SDA) SDA Header
3" F-27 SDA Flare Drum
31-F-6 DDS Flare Drum
Q(DDS) DDS Header
Q(C3) Propane Bullet Header
Q(1SRU) #1 SRU Header
Q(ISOM) ISOM Header
Q(LPVGO) LPVGO Header
Q(HPH) Hydrogen Plant Header
Q(18KDS) 18" KDS Header
Q(NPT) NPT Header
Q(HPCCR) HPCCR Header
Q(HPVGO) HPVGO Flare Header
Q(12KDS) 12" KDS Flare Header
11-F-14 "New" NNA Flare Drum
Fuel Gas Sweep
Supplemental Gas
Q(2SRU) #2 SRU Header
Q(FW) FW Vent Gas Adsorber
Q(Deb) Debut Rundown
Q(npt R) NPT Rundown
11-F-9 "Old" NNA Flare Drum
Q(#3) #3 Crude Flare Header

NNA (Qs)	Sources	Detailed Source Description
Q(#3) #3 Crude Relief Header	10 PSVs	2-2-PSV-152 on 2-2-F-87 Stranded Gas KO Drum
		2-1-PSV-6 on 2-23-F-32 Preflas Ovhd line
		2-23-PSV-35 on 2-23-F-7 Frac Ovhd receiver
		2-011-PSV-5 on 2-111-F-1 FWS Charge Drum
		2-24-PSV-85 on 2-24-F-54 FCC FWS Charge Drum
		2-106-PSV-151 on 2-106-F-115 NA Rich Amine Flash Drum
		2-5-PSV-70 on 2-5-F-24 HPVGO Feed Filter
		2-5-PSV-71 on 2-5-F-25 HPVGO Feed Filter
		2-5-PSV-72 on 2-5-F-26 Import Filter
		2-5-PSV-73 on 2-5-F-27 Import Filter
	3 PCVs	2-2-PV-518 on 2-2-F-87 Stranded Gas KO
		2-23-PC-38 on OH Reciever
		2-23-PV-11B on 2-23-F-7 Frac Ovhd Receiver
	13 Block Valves	2-2-F-87 Stranded Gas KO Drum
		2-2-F-87 Stranded Gas line vent
		Bypass for 2-1-PSV-6 on 2-23-F-32 Preflas Ovhd line
		Bypass for 2-111-PSV-5 on 2-111-F-1 FWS Charge Drum
		Bypass for 2-24-PSV-85 on 2-24-F-54 FCC FWS Charge Drum
		2-106-F-115 NA Rich Amine Flas Drum
		2-106-F-115 NA Rich Amine FD off-gas
		Bypass for 2-5-PSV-70 on 2-5-F-24 HPVGO Feed Filter
		Bypass for 2-5-PSV-71 on 2-5-F-25 HPVGO Feed Filter
		Bypass for 2-5-PSV-72 on 2-5-F-26 Import Filter
		Bypass 2-5-PSV-73 on 2-5-F-27 Import Filter
		18" relief line from MTBE Unit
		South Area Flare to NNA Flare
Q(2SRU) #2 SRU Header	6 PSVs	2-119-PSV-3 on 2-119-F-1 Acid Gas Separator Off-gas
		2-119-PSV-4 on 2-119-F-2 FWS Gas Separator Off-gas
		2-119-PSV-19 on 2-119-F-3 Off-gas Sep Ovhd to SCOT
		2-118-PSV-1 on 2-118-F-10 Rich Amine Flash Drum
		2-118-PSV-13 on 2-118-F-3 Amine Regen Ovhd Rec
		2-120-PSV-3 on 2-120-B-1 inlet H2 from Hydrogen header
	6 Block Valves	Valves Block on2-119-F-1 Acid Gas Separator Off-gas PV-1 Bypass
		Valves Block on2-119-F-2 FWS Gas Separator Off-gas PV-2 Bypass
		Valves Bock valve at pump on2-118-F-10 Rich Amine Flash Drum oily liq
		Valves Block on2-118-F-10 Rich Amine Flash Drum PSV-1 Bypass
		Valves Block on2-118-F-10 Rich Amine Flash Drum Off-gas
		Bypass Valve 2-120-PV-19A on2-120-F-3 Stripper Ovhd Rec Off-gas
	3 Control Valve	Control Valve 2-119-PV-1 on2-119-F-1 Acid Gas Separator Off-gas
		Control Valve 2-119-PV-2 on2-119-F-2 FWS Gas Separator Off-gas
		Control Valve 2-120-PV-19A on2-120-F-3 Stripper Ovhd Rec Off-gas

NNA (Qs)	Sources	Detailed Source Description
Q(DDS) DDS Header	44 PSV's	2-121-PSV-1 on 2-121-F-1 Feed Surge Drum
		2-121-PSV-26 on 2-121-F-1 Feed Surge Drum
		2-121-PSV-41 on 2-121-E-2E(S) outler A-train Feed to Rx Charge Htr
		2-121-PSV-11 on 2-121-E-3 (S) inlet M/U & Rec H2 from 2-121-G-1/2
		2-121-PSV-15A on 2-121-E-5B (S) outlet A side Rx Eff to Rx Eff Separator
		2-121-PSV-15B on 2-121-E-5B (S) outlet A side Rx Eff to Rx Eff Separator
		2-121-PSV-10 on 2-121-E-7E(S) outlet B train Feed to Rx Charge Heater
		2-121-PSV-40 on 2-121-E-8 (S) inlet M/U & Rec H2 from 2-121-G-1/2
		2-121-PSV-51A on 2-121-E-40B (S) inlet B side Rx Eff to Rx Eff Separator
		2-121-PSV-51B on 2-121-E-40B (S) inlet B side Rx Eff to Rx Eff Separator
		2-121-PSV-68 on 2-121-F-5 HPFD
		2-121-PSV-69A on 2-121-F-6 LPFD
		2-121-PSV-69B on 2-121-F-6 LPFD
		2-121-PSV-69C on 2-121-F-6 LPFD
		2-121-PSV-69D on 2-121-F-6 LPFD
		2-121-PSV-69E on 2-121-F-6 LPFD
		2-121-PSV-77 on 2-121-F-2 M/U H2 Suction Drum
		2-121-PSV-78 on 2-121-G-1 M/U H2 Comp Discharge
		2-121-PSV-79 on 2-121-G-1 Recycle H2 Comp Discharge
		2-121-PSV-80 on 2-121-G-2 M/U H2 Comp Discharge
		2-121-PSV-85 on 2-121-G-2 Recycle H2 Comp Discharge
		2-121-PSV-95 on 2-121-F-3 M/U H2 Comp Discharge
		2-121-PSV-98 on 2-121-F-4 Recycle H2 Comp Discharge
		2-121-PSV-118 on 2-121-D-1 Recycle Gas Scruber
		2-121-PSV-114A on 2-121-F-7 Rich Amine Flash Drum
		2-121-PSV-114B on 2-121-F-7 Rich Amine Flash Drum
		2-121-PSV-137A on 2-121-D-2 Product Stripper
		2-121-PSV-137B on 2-121-D-2 Product Stripper
		2-121-PSV-137C on 2-121-D-2 Product Stripper
		2-121-PSV-155 on 2-121-E-13A (T) inlet Product Stripper Bottoms
		2-121-PSV-156 on 2-121-E-13E (T) inlet Product Stripper Bottoms
		2-121-PSV-153 on 2-121-E-13I (T) inlet Product Stripper Bottoms
		2-121-PSV-150 on 2-121-E-13A (S) outlet LPFD Liquid to Stripper
		2-121-PSV-151 on 2-121-E-13E (S) outlet LPFD Liquid to Stripper
		2-121-PSV-152 on 2-121-E-13I(S) outlet LPFD Liquid to Stripper
		2-121-PSV-258 on 2-121-E-41A (S) outlet LPFD Liquid to Stripper
		2-121-PSV-263 on 2-121-E-41A (t) inlet Product Stripper Bottoms
		2-121-PSV-177 on 2-121-E-15A (t) inlet Product Stripper Bottoms
		2-121-PSV-226A on 2-121-F-8 Stripper Ovhd Reciever
		2-121-PSV-226B on 2-121-F-8 Stripper Ovhd Reciever
		2-121-PSV-252 on 2-121-GC-6 Stripper Ovhd Reciever Off-gas
		2-121-PSV-255 on 2-121-GC-5 Stripper Ovhd Reciever Off-gas
		2-121-PSV-256 on 2-121-GC-5/6 Stripper Ovhd Reciever Off-gas
		2-121-PSV-350 on 2-121-F-14 Fuel Gas KO Drum
		2-66-PSV-17 on 2-121-E-22 6" line from RV at PCV-31 DDS Off gas to Sur Fuel Normaly Blocked
	3 Compressor Seals	Compressor Seals 2-121-GC-1 M/U & Recycle Comp Pres Pac vent
		Compressor Seals 2-121-GC-6 Strip OG Comp Press Pack vent
		Compressor Seals 2-121-GC-5 Strip OG Comp Press Pack vent
	1 Sample Station	

NNA (Q_s)	Sources	Detailed Source Description
$Q_{(DDS)}$ DDS Header	53 Block Valves	Bypass 2-121-PSV-1 on 2-121-F-1 Feed Surge Drum 1
		Bypass 2-121-PSV-1 on 2-121-F-1 Feed Surge Drum 2
		2-121-E-10B(s) outlet Aside Rx Eff to Rx Eff Separator
		B side evacuation line
		Bypass 2-121-PSV-68 on 2-121-F-5 HPFD 1
		Bypass 2-121-PSV-68 on 2-121-F-5 HPFD 2
		Bypass 2-121-PSV-69E on 2-121-F-6 LPFD
		Bypass 2-121-PSV-77 on 2-121-F-2 M/U H2 Suction Drum 1
		Bypass 2-121-PSV-77 on 2-121-F-2 M/U H2 Suction Drum 2
		Bypass2-121-PSV-78 on 2-121-G-1 M/U H2 Comp Discharge 1
		Bypass2-121-PSV-78 on 2-121-G-1 M/U H2 Comp Discharge 2
		Bypass2-121-PSV-79 on 2-121-G-1 Recycle H2 Comp Discharge 1
		Bypass2-121-PSV-79 on 2-121-G-1 Recycle H2 Comp Discharge 2
		Bypass2-121-PSV-80 on 2-121-G-2 M/U H2 Comp Discharge 1
		Bypass2-121-PSV-80 on 2-121-G-2 M/U H2 Comp Discharge 2
		Bypass2-121-PSV-85 on 2-121-G-2 Recycle H2 Comp Discharge 1
		Bypass2-121-PSV-85 on 2-121-G-2 Recycle H2 Comp Discharge 2
		2-121-E-16A inlet M/U H2 Comp Discharge
		2-121-E-19A inlet M/U H2 Comp Discharge
		Bypass 2-121-PSV-95 on 2-121-F-3 inlet M/U H2 Comp Discharge 1
		Bypass 2-121-PSV-95 on 2-121-F-3 inlet M/U H2 Comp Discharge 2
		Bypass 2-121-PSV-98 on 2-121-F-4 Recycle H2 Comp Discharge 1
		Bypass 2-121-PSV-98 on 2-121-F-4 Recycle H2 Comp Discharge 2
		Bypass 2-121-PSV-118 on 2-121-D-1 Recycle Gas Scruber 1
		Bypass 2-121-PSV-118 on 2-121-D-1 Recycle Gas Scruber 2
		Bypass 2-121-PSV-114B on 2-121-F-7 Rich Amine Flash Drum 1
		Bypass 2-121-PSV-114B on 2-121-F-7 Rich Amine Flash Drum 2
		Bypass 2-121-PSV-137A on 2-121-D-2 Product Stripper 1
		Bypass 2-121-PSV-137A on 2-121-D-2 Product Stripper 2
		2-121-E-13A (S) outlet LPFD Liquid to Stripper
		2-121-E-13E (S) outlet LPFD Liquid to Stripper
		2-121-E-13I(S) outlet LPFD Liquid to Stripper
		Bypass 2-121-PSV-263 on 2-121-E-41A (t) inlet Product Stripper Bottoms
		2-121-E-41A (s) outlet LPFD liquid to stripper
		2-121-E-12A (s) inlet Stripped Ovhd
		Bypass 2-121-PSV-226A on 2-121-F-8 Stripper Ovhd Reciever 1
		Bypass 2-121-PSV-226A on 2-121-F-8 Stripper Ovhd Reciever 2
		Block downstream CV bypass on 2-121-F-8 Stripper Ovhd Reciever Off-gas
		Bypass 2-121-PSV-252 on 2-121-GC-6 Stripper Ovhd Reciever Off-gas 1
		Bypass 2-121-PSV-252 on 2-121-GC-6 Stripper Ovhd Reciever Off-gas 2
		Bypass 2-121-PSV-255 on 2-121-GC-5 Stripper Ovhd Reciever Off-gas 1
		Bypass 2-121-PSV-255 on 2-121-GC-5 Stripper Ovhd Reciever Off-gas 2
		Bypass 2-121-PSV-350 Fuel Gas KO Drum
		2-121-F-14 Fuel Gas KO Drum Liquid
		2-121-GC-1 m/u & Recycle Comp Dis P vent
		2-121-GC-2 m/u & recycle comp dis P vent
		2-121-GC-6 Suction Snubber blowdown
		2-121-GC-6 Strip OG Comp Dist P vent
		2-121-F-16 MDEA KO Drum Off-gas
		2-121-E-5 4" line from B1 train reactor Evacuation line to Flare
		2-121-GC-5 Strip OG Comp Dist P Vent
		2-121-GC-5 Suction Snubber blowdown

NNA (Qs)	Sources	Detailed Source Description
Q(HPCCR) HPCCR Header	15 PSV's	2-102-PSV-47 on 2-102-E-37 (S) inlet Debutanizer bottoms
		2-102-PSV-48 on 2-102-E-37 (T) outlet Debutanizer feed
		2-102-PSV-532 on 2-102-F-3 LPF Separator Ovhd line
		2-102-PSV-43A on 2-102-GC-33 H2 line from comp dis drum
		2-102-PSV-43B on 2-102-GC-33 H2 line from comp dis drum
		2-102-PSV-42A on 2-102-GC-33 H2 line from comp Recy dis drum
		2-102-PSV-42B on 2-102-GC-32 H2 line from comp Recy dis drum
		2-102-PSV-488 on 2-102-D-2 Debutanizer Tower Ovhd line
		2-102-PSV-1005 on 2-102-F-21 H2 Compressor Disch Drum
		2-102-PSV-926 on Hydrogen Charge
		2-102-PSV-927 on 2-102-F-35 Hydrogen KO Drum
		2-102-PSV-609 on 2-102-F-15 Fuel Gas KO Drum
		2-102-PSV-1013 on 2-102-F-60 HPCCR Netgas (H2) Coalescer
		2-102-PSV-20 on 2-102-F-9 Lock Hopper # 1 vent gas
		2-102-PSV-556 on 2-102-E-10 (T) inlet Debutanizer bottoms
	2 Control Valves	2-102-PV-51C on 2-102-F-4 High Pressure Sep Ovhd line
		2-102-PT-301 on Supply Nitrogen
	28 Block Valves	2-102-F-15 Fuel Gas KO Drum Bottoms
		2-102-GC-30 Seal Oil Trap vent
		Bypass 2-102-PSV-43A on 2-102-F-3 on Recycle Suction of G-32 1
		Bypass 2-102-PSV-43A on 2-102-F-3 on Recycle Suction of G-32 2
		Bypass 2-102-PSV-43B on 2-102-GC-33 H2 line from comp dis drum 1
		Bypass 2-102-PSV-43B on 2-102-GC-33 H2 line from comp dis drum 2
		Bypass 2-102-PSV-42A on 2-102-GC-33 H2 line from comp Recy dis drum 1
		Bypass 2-102-PSV-42A on 2-102-GC-33 H2 line from comp Recy dis drum 2
		Bypass 2-102-PSV-42B on 2-102-GC-32 H2 line from comp Recy dis drum 1
		Bypass 2-102-PSV-42B on 2-102-GC-32 H2 line from comp Recy dis drum 2
		(by pass)2-102-PV-51C on 2-102-F-4 High Pressure Sep Ovhd line
		2-102-F-7 Booster Suction of G-32 1
		2-102-F-7 Booster Suction of G-32 2
		2-102-F-7 Booster Suction of G-33 1
		2-102-F-7 Booster Suction of G-33 2
		2-102-HV-99 on 2-102-F-21 H2 Compressor Disch Drum
		2-102-F-5 Debutanizer Ovhd Receiver
		2-102-G-7 pump vents
		2-102-G-6 pump vents
		2-102-GC-30 Recycle Gas Compressor (Suc/Dis)
		Bypass 2-102-PSV-1013 on 2-102-F-60 HPCCR Netgas (H2) Coalescer 1
		Bypass 2-102-PSV-1013 on 2-102-F-60 HPCCR Netgas (H2) Coalescer 2
		2-102-F-3 Recyle Suction of G-32 1
		2-102-F-3 Recyle Suction of G-32 2
		2-102-F-3 Recyle Suction of G-33 1
		2-102-F-3 Recyle Suction of G-33 2
		Bypass 3-102-PSV-48 on 2-102-E-37 (T) outlet Debutanizer feed
		Bypass 2-102-PSV-47 on 2-102-E-37 (S) inlet Debutanizer bottoms

NNA (Qs)	Sources	Detailed Source Description
Q(NPT) NPT Flare Header	14 PSVs	2-101-PSV-36 on 2-101-G-2A/B outlet Naphtha Charge Pumps
		2-101-PSV-93 on 2-101-FF-10 Naphtha Pretreater Feed Filter
		2-101-PSV-94 on 2-101-FF-11 Naphtha Pretreater Feed Filter
		2-101-PSV-41 on 2-101-E-7A/B outlet LPFD
		2-101-PSV-39 on 2-101-E-7A/B outlet HPFD
		2-101-PSV-47 on 2-101-E-7A/B outlet Stripper Ovhd. Line
		2-101-PSV-89 on 2-101-E-7A/B outlet Stripper Ovhd. Accumulator
		2-101-PSV-45 on 2-101-E-7A/B outlet Recycle Hydrogen Discharge
		2-101-PSV-44 on 2-101-E-7A/B outlet Makeup Hydrogen Discharge
		2-101-PSV-43 on 2-101-E-7A/B outlet Recycle Hydrogen Discharge
		2-101-PSV-42 on 2-101-E-7A/B outlet Make-up Hydrogen Discharge
		2-101-PSV-40 on 2-101-E-7A/B outlet Make-up H2 on KO Pot
		2-101-PSV-88 on 2-101-E-7A/B outlet Fuel Gas KO Pot
		2-101-PSV-90 on 2-101-E-7A/B outlet naptha to Reformer
	1 Compressor Seal	Compressor Seals 2-101-GC-1/2 Compressor Packing Vents
	12 Block Valves	Bypass 2-101-PSV-93 on 2-101-FF-10 Naphtha Pretreater Feed Filter
		Bypass 2-101-PSV-94 on 2-101-FF-11 Naphtha Pretreater Feed Filter
		2-101-G-4A/B/C Stripper Bottoms Pump Vent 1
		2-101-G-4A/B/C Stripper Bottoms Pump Vent 2
		2-101-E-7A/B outlet Recycle H2 KO Drum
		2-101-E-7A/B outlet Hydrogen Discharge Snubber Vents
		2-101-E-7A/B outlet Snubber KO pots 1
		2-101-E-7A/B outlet Snubber KO pots 2
		2-101-E-7A/B outlet Fuel Gas KO Pot Drain
		2-101-E-7B outlet Pump Vents
		2-101-E-7A/B outlet Compressor Packing Vent
		2-101-E-7 outlet Pump Vents
Q(HPVGO) HPVGO Flare Header	24 PSVs	2-104-PSV-9 on 2-104-F-9 Amine Flash Drum
		2-104-PSV-72 on 2-104-D-2 Stripper Ovhd line
		2-104-PSV-3 on 2-104-F-1 Feed Surge Drum
		2-104-PSV-10 on 2-104-D-1 Recycle Gas Scrubber Ovhd
		2-104-PSV-70 on 2-104-F-3 Hot Flash Drum
		2-104-PSV-71 on 2-104-F-3 Hot Flash Drum
		2-104-PSV-36 on 2-104-F-6 LPFD (via RGKOP)
		2-104-PSV-143 on 2-104-F-10 Stripper Ovhd Rec
		2-104-PSV-16 on 2-104-F-5 Cold Flash Drum (via RGKOP)
		2-104-PSV-85 on 2-104-F-25 H2 Comp 1st Stg M/U Suc Drum
		2-104-PSV-95 on 2-104-GC-7 1st Stage M/U discharge
		2-104-PSV-124 on 2-104-GC-7 Recycle Stage discharge
		2-104-PSV-125 on 2-104-GC-7 2nd Stage M/U discharge
		2-104-PSV-97 on 2-104-GC-8 1st Stage M/U discharge
		2-104-PSV-123 on 2-104-GC-8 2nd Stage M/U discharge
		2-104-PSV-76 on 2-104-GC-8 Recycle Stage discharge
		2-104-PSV-7 on 2-104-F-21 Fuel Gas KO Pot
		2-104-PSV-134A on 2-104-E-47A (S) outlet B-1 Rx Effluent to HP Sep
		2-104-PSV-134B on 2-104-E-48A (S) outlet B-1 Rx Effluent to HP Sep
		2-104-PSV-87 on 2-104-F-26 H2 Comp 2nd Stg M/U Suc Drum
		2-104-PSV-78 on 2-104-FF-1/2/21 outlet Non-Permeate H2
		2-104-PSV-77 on 2-104-FF-3 inlet He purge from 2-104-F-27
		2-104-PSV-130 on 2-104-FF-1 inlet Recycle Hydrogen
		2-104-PSV-129 on 2-104-FF-2 inlet Recycle Hydrogen
		2-104-PSV-128 on 2-104-FF-21 inlet Recycle Hydrogen

NNA (Q_S)	Sources	Detailed Source Description
$Q_{(HPVGO)}$ HPVGO Flare Header	51 Block Valves	Block on 2-104-F-10 Sample Sta Stripper Ovhd Liquid
		Bypass 2-104-PV-9B on 2-104-PV-9B Feed Surge Drum
		Bypass 2-104-PSV-10 on 2-104-D-1 Recycle Gas Scrubber Ovhd 1
		Bypass 2-104-PSV-10 on 2-104-D-1 Recycle Gas Scrubber Ovhd 2
		Block on 2-104-F-2 Hot Separator Inlet from E-47 A/B
		Block on 2-104-F-2 Hot Separator Inlet from E-48 A/B
		Bypass 2-104-PSV-36 on 2-104-F-6 LPFD (via RGKOP) 1
		Bypass 2-104-PSV-36 on 2-104-F-6 LPFD (via RGKOP) 2
		Bypass 2-104-PSV-143 on 2-104-F-10 Stripper Ovhd Rec 1
		Bypass 2-104-PSV-143 on 2-104-F-10 Stripper Ovhd Rec 2
		Block on 2-104-F-10 Stripper Ovhd Rec
		Bypass 2-104-PSV-16 on 2-104-F-5 Cold Flash Drum (via RGKOP) 1
		Bypass 2-104-PSV-16 on 2-104-F-5 Cold Flash Drum (via RGKOP) 2
		Bypass 2-104-PSV-85 on 2-104-F-25 H2 Comp 1st Stg M/U Suc Drum 1
		Bypass 2-104-PSV-85 on 2-104-F-25 H2 Comp 1st Stg M/U Suc Drum 2
		Bypass 2-104-PSV-95 on 2-104-GC-7 2nd Stage M/U discharge 1
		Bypass 2-104-PSV-95 on 2-104-GC-7 2nd Stage M/U discharge 2
		Bypass 2-104-PSV-124 on 2-104-GC-7 Recycle Stage discharge 1
		Bypass 2-104-PSV-124 on 2-104-GC-7 Recycle Stage discharge 2
		Block on 2-104-GC-7 1st Stage Distance piece vent 1
		Block on 2-104-GC-7 1st Stage Unloader
		Bypass 2-104-PSV-125 on 2-104-GC-7 3rd Stage M/U discharge 1
		Bypass 2-104-PSV-125 on 2-104-GC-7 3rd Stage M/U discharge 2
		Block on 2-104-GC-7 2nd Stage Unloader
		Block on 2-104-GC-7 2nd Stage Distance piece vent
		Block on 2-104-GC-7 Recycle Stage Dist piece vent
		Block on 2-104-GC-7 Recycle Stage Unloader
		Bypass 2-104-PSV-97 on 2-104-GC-8 2nd Stage M/U discharge 1
		Bypass 2-104-PSV-97 on 2-104-GC-8 2nd Stage M/U discharge 2
		Block on 2-104-GC-8 1st Stage Distance piece vent
		Block on 2-104-GC-8 1st Stage Unloader
		Bypass 2-104-PSV-123 on 2-104-GC-8 3rd Stage M/U discharge 1
		Bypass 2-104-PSV-123 on 2-104-GC-8 3rd Stage M/U discharge 2
		Block on 2-104-GC-8 2nd Stage Unloader
		Block on 2-104-GC-8 2nd Stage Distance piece vent
		Bypass 2-104-PSV-76 on 2-104-GC-8 Recycle Stage discharge 1
		Bypass 2-104-PSV-76 on 2-104-GC-8 Recycle Stage discharge 2
		Block on 2-104-GC-8 Recycle Stage Dist piece vent
		Block on 2-104-GC-8 Recycle Stage Unloader
		Block on 2-104-F-21 Fuel Gas KO Pot Drain to Flare
		Block on 2-104-F-8 Recycle Gas Flare - HV-110
		Block on 2-104-F-8 Recycle Gas Comp Suction Drum
		Bypass 2-104-PSV-87 on 2-104-F-26 H2 Comp 2nd Stg M/U Suc Drum 1
		Bypass 2-104-PSV-87 on 2-104-F-26 H2 Comp 2nd Stg M/U Suc Drum 2
		Block on 2-104-FF-1/2/21 outlet Non-Permeate H2 PSV-78 Bypass
		Block on 2-104-GC-7 1st Stage Packing vent
		Block on 2-104-GC-7 2nd Stage Packing vent
		Block on 2-104-GC-7 Recycle Stage Packing vent
		Block on 2-104-GC-8 1st Stage Packing vent
		Block on 2-104-GC-8 2nd Stage Packing vent
		Block on 2-104-GC-8 Recycle Stage Packing vent
	5 Sample Stations	

NNA (Qs)	Sources	Detailed Source Description
Q(HPVGO) HPVGO Flare Header	6 Compressor Seals	Compressor Seals 2-104-GC-7 1st Stage Packing vent
		Compressor Seals 2-104-GC-7 2nd Stage Packing vent
		Compressor Seals 2-104-GC-7 Recycle Stage Packing vent
		Compressor Seals 2-104-GC-8 1st Stage Packing vent
		Compressor Seals 2-104-GC-8 2nd Stage Packing vent
		Compressor Seals 2-104-GC-8 Recycle Stage Packing vent
	2 Control Valves	2-104-PV-9B on 2-104-F-1 Feed Surge Drum
		2-104-PV-108 on 2-104-F-8 Recycle Gas Comp Suction Drum
Q(ISOM) ISOM Header	37 PSV's	2-35-PSV-57 on 2-35-F-8 Feed Surge Drum Pump-out
		2-35-PSV-38 on 2-35-B-2 Hot Oil Heater
		2-35-PSV-61 on 2-35-E-45A/B (S) inlet DesuL Stripper Bottoms
		2-35-PSV-27 on 2-35-D-3 Penex Feed Dryer
		2-35-PSV-28 on 2-35-D-4 Penex Feed Dryer
		2-35-PSV-48 on 2-35-F-14 LPFD
		2-35-PSV-5 on 2-35-D-2 DesuL Stripper Ovhd line
		2-35-PSV-34 on 2-35-D-10 Debutanizer Ovhd line
		2-35-PSV-1 on 2-35-F-1 DesuLurizer Feed Drum
		2-35-PSV-30 on 2-35-E-12 (S) outlet Penex Charge
		2-35-PSV-39 on 2-35-F-8 Penex Feed Drum
		2-35-PSV-56 on 2-35-F-7 Hot Oil Surge Drum
		2-35-PSV-14 on 2-35-F-7 Hot Oil Surge Drum
		2-35-PSV-15 on on 2-35-F-7
		2-35-PSV-58 on 2-35-F-3 DesuLurizer Rx Products Sep.
		2-35-PSV-33 on 2-35-F-9 Penex Rx Products Separator
		2-35-PSV-54 on 2-35-F-17 (GC-11/12) Recycle Comp Discharge Drum
		2-35-PSV-16 on 2-35-F-13 Make-up H2 KO Drum
		2-35-PSV-36 on 2-35-F-12 Purge Gas Vent Drum
		2-35-PSV-35 on 2-35-D-12 Debut Off-Gas Scrubber
		2-35-PSV-47 on 2-35-F-40 (GC-11) Recycle Comp Discharge Snub
		2-35-PSV-46 on 2-35-F-41 (GC-12) Recycle Comp Discharge Snub
		2-35-PSV-25 on 2-35-F-38 (GC-11) Penex Comp 2nd Stage Disch
		2-35-PSV-26 on 2-35-F-39 (GC-12) Penex Comp 2nd Stage Disch
		2-35-PSV-31 on 2-35-D-5 Penex Rx inlet
		2-35-PSV-32 on 2-35-D-6 Penex Rx inlet
		2-35-PSV-3 on 2-35-GC-4 Desul Recycle H2 Discharge
		2-35-PSV-12 on 2-35-GC-4 Desul Recycle H2 Discharge
		2-35-PSV-4 on 2-35-GC-5 Desul Recycle H2 Discharge
		2-35-PSV-11 on 2-35-GC-5 Desul Recycle H2 Discharge
		2-35-PSV-23 on 2-35-F-36 (GC-11) 1st Stage Discharge Snubber
		2-35-PSV-24 on 2-35-F-37 (GC-12) 1st Stage Discharge Snubber
		2-35-PSV-22 on 2-35-F-10 Penex 2nd Stage Suction Drum
		2-35-PSV-13 on 2-35-F-6 DesuL Make-up H2 Suction Drum
		2-35-PSV-17 on 2-35-D-7 Make-up Gas Dryer
		2-35-PSV-18 on 2-35-D-8 Make-up Gas Dryer
		2-35-PSV-20 on 2-35-F-11 Penex 1st Stage Suction Drum

NNA (Q_s)	Sources	Detailed Source Description
$Q_{(ISOM)}$ ISOM Header	39 Block Valves	Bypass Valve on 2-35-B-2 Hot Oil Heater PSV-38 Bypass (1)
		Bypass Valve on 2-35-B-2 Hot Oil Heater PSV-38 Bypass (2)
		Bypass Valve on 2-35-E-45A/B (S) inlet DesuL Stripper Bottoms
		Valve on 2-35-G-99/100 Debut Reflux Pumps vent
		Bypass Valve on 2-35-D-3 Penex Feed Dryer
		Bypass Valve on 2-35-D-4 Penex Feed Dryer
		Valves on 2-35-D-6 Penex Rx outlet
		Valves on 2-35-D-5 Penex Rx outlet
		Bypass Valve on 2-35-F-12 Purge Gas Vent Drum
		Valve on 2-35-F-8 Penex Feed Drum Vent (to tailpipe of PSV-39)
		Bypass Valve on 2-35-F-7 Hot Oil Surge Drum Make-up H3
		Valve on 2-35-F-15 Debut Ovhd Receiver
		Valve on 2-35-F-17 (GC-11/12) Recycle Comp Discharge Drum
		Valves on 2-35-F-5 DesuL Stripper Ovhd Rec
		Valves on 2-35-F-13 Make-up H2 KO Drum Bottoms
		Valve on 2-35-F-40 (GC-11) Recycle Comp Discharge Snub
		Valve on 2-35-F-41 (GC-12) Recycle Comp Discharge Snub
		Valve on 2-35-F-38 (GC-11) Penex Comp 2nd Stage Disch
		Valve on 2-35-F-38 (GC-11) Penex Comp 2nd Stage Disch
		Valves on 2-35-GC-4 Desul Recycle H2 Discharge
		Valve on 2-35-GC-4 Desul Recycle H2 Discharge
		Valve on 2-35-GC-5 Desul Recycle H2 Discharge
		Valve on 2-35-GC-5 Desul Recycle H2 Discharge
		Valve on 2-35-F-36 (GC-11) 2nd Stage Discharge Snubber
		Valve on 2-35-F-36 (GC-11) 2nd Stage Discharge Snubber
		Bypass Valve on 2-35-F-10 Penex 2nd Stage Suction Drum
		Valve on 2-35-F-4 DesuL Recycle Suction Drum
		Bypass Valve PSV-17 Bypass on 2-35-D-7 Make-up Gas Dryer 1
		Bypass Valve PSV-17 Bypass on 2-35-D-7 Make-up Gas Dryer 2
		Bypass Valves on 2-35-D-8 Make-up Gas Dryer 1
		Bypass Valves on 2-35-D-8 Make-up Gas Dryer 2
		Valves (x2) on 2-35-D-7/8 Make-up H2 Vent
		Valves on 2-35-B-3 Hot Regen Gas RO Vent
		Valves on Fuel Gas
		Bypass Valve on 2-35-F-11 Penex 1st Stage Suction Drum
		Valves on 2-35-GC-4 Packing Gland Vents
		Valves on 2-35-GC-5 Packing Gland Vents
		Valves on 2-35-GC-11 Packing Gland Vents
		Valves on 2-35-GC-12 Packing Gland Vents
	1 Sample Station	
	6 Control Valves	Control Valve on 2-35-F-1 DesuLurizer Feed Drum
		Control Valve on 2-35-F-12 Purge Gas Vent Drum
		Control Valve on 2-35-F-1 DesuLurizer Feed Drum
		Control Valve on 2-35-F-7 Hot Oil Surge Drum Make-up H2
		Control Valve on 2-35-F-10 Penex 2nd Stage Suction Drum
		Control Valve on 2-35-F-11 Penex 1st Stage Suction Drum

NNA (Qs)	Sources	Detailed Source Description
$Q_{(1SRU)}$ #1 SRU Header	13 PSVs	2-106-PSV - 302 6" line from FWS Separator 106-F-302
		2-106-PSV - 301 8" line from Acid Gas Separator 106-F-301
		2-106-PSV - 145 4" line from 106-F-113 NNA FW Charge Drum
		2-106-PSV -325 4" line from RV on 106-F-304
		2-106-PSV - 111 10" line from Acid Fas Line on 106-D-101
		2-106-PSV - 134 6" line from NNA FWS 106-D-103
		2-106-PSV - 163 6" line from Aux FW Charge Drum 106-F-108
		2-106-PSV - 101A 6" l ine from Rich Amine Flash Drum 106-F-321
		2-106-PSV - 166 3" line from Aux FWS 106-F-104
		2-66-PSV-8 on 2-66-F-10 #12 Fuel Gas KO drum
		2-107-PSV-3 on 2-107-B-1 inlet H2 from HPCCR
		2-107-PSV-15 on 2-107-D-4 FW Surge Tanks Vent Gas Abs
		2-106-PSV - 106 2" line from 106-F-102 Filter Backwash Drum
	16 Block Valves	Block on 2-106-F-117 FW Tks Vent Gas KO Pot liquid
		Block on 2-106-F-302 FWS Gas Separator Off-gas Bypass
		Block on 2-24-D-41 FCC FWS Off-gas
		Block on 2-106-D-104/F-301 Aux FWS Off-gas/Amine Gas
		Bypass 2-106-PV-102A on 2-106-F-301 Acid Gas Separator Off-gas
		Block on 2-106-F-321 Skimmed Oil
		Bypass Valve 2-106-PSV-101A on 2-106-F-321 Rich Amine Flash Drum
		Valves Block on 2-106-F-321 Rich Amine FD Hydrocarbon
		Valves Block on 2-106-F-321 Rich Amine FD Hydrocarbon
		Bypass Valve 2-66-PSV-8 on 2-66-F-10 #12 Fuel Gas KO drum 1
		Bypass Valve 2-66-PSV-8 on 2-66-F-10 #12 Fuel Gas KO drum 2
		Valves Block on 2-66-F-10 N0. 12 Boiler Fuel Gas Drum
		Bypass Valve 2-66-LV-24 on 2-66-F-10 N0. 12 Boiler Fuel Gas Drum
		Valves Block on 2-107-D-2 Absorber Ovhd to 2-107-B-1
		Valves Block on 2-107-F-3 Stripper Ovhd Rec Off-gas PSV-19A Bypass
		Bypass Valve 2-107-PSV-15 on 2-107-D-4 FW Surge Tanks Vent Gas Abs
	4 Control Valves	Control Valve 2-107-PV-19A on 2-107-F-3 Stripper Ovhd Rec Off-gas
		Control Valve 2-66-LV-24 on 2-66-F-10 N0. 12 Boiler Fuel Gas Drum
		2-106-PV-302 on 2-106-F-302 FWS Gas Separator Off-gas
		2-106-PV-102A on 2-106-F-301 Acid Gas Separator Off-gas
$Q_{(18kds)}$ 18" KDS Header	15 PSV's Valves	2-122-PSV-1 on 2-122-F-1 Feed Surge Drum
		2-122-PSV-2 on 2-122-E-11 (T) inlet Product Stripper Bottoms
		2-122-PSV-3 on 2-122-E-11 (S) outlet Kerosene to Feed Surge Drum
		2-122-PSV-7 on 2-122-F-3 Product Separator
		2-122-PSV-8 on 2-122-F-2 M/U H2 Comp Suction Drum
		2-122-PSV-10 on 2-122-GC-1 M/U H2 Comp Discharge
		2-122-PSV-11 on 2-122-GC-1 Recycle H2 Comp Discharge
		2-122-PSV-12 on 2-122-GC-2 M/U H2 Comp Discharge
		2-122-PSV-55 on 2-122-GC-2 Recycle H2 Comp Discharge
		2-122-PSV-14 on 2-122-E-6A (T) inlet Product Stripper Bottoms
		2-122-PSV-57 on 2-122-E-6C (T) inlet Product Stripper Bottoms
		2-122-PSV-58 on 2-122-E-6C (S) outlet Product Separator to Stripper
		2-122-PSV-56 on 2-122-E-6A (S) outlet Product Separator to Stripper
		2-122-PSV-16 on 2-122-F-4 Stripper Ovhd Receiver
		2-122-PSV-17 on 2-122-F-5 Prod Stripper Btms Coalescer
	1 Control Valve	Split Range Control Valve on 2-122-F-12" line from Split Ranger Control Vent on 122-F-1
	4 Sample Stations	
	1 Pump Seal	2-122-G-7/8 1" line from 122-G-7/8 Seal Vents

NNA (Qs)	Sources	Detailed Source Description
Q(18kds) 18" KDS Header	49 Block Valves	2-122-PSV-1 bypass on 2-122-F-1Feed Surge Drum 1
		2-122-PSV-1 bypass on 2-122-F-1Feed Surge Drum 2
		2-122-PSV-2 bypass on 2-122-E-11 (T) inletProduct Stripper Bottoms 1
		2-122-PSV-2 bypass on 2-122-E-11 (T) inletProduct Stripper Bottoms 2
		2-122-PSV-3 bypass on 2-122-E-11 (S) outletKerosene to Feed Surge Drum 1
		2-122-PSV-3 bypass on 2-122-E-11 (S) outletKerosene to Feed Surge Drum 2
		2-122-PSV-7 bypass on 2-122-F-3Product Separator 1
		2-122-PSV-7 bypass on 2-122-F-3Product Separator 2
		2-122-PSV-8 bypass on 2-122-F-2M/U H2 Comp Suction Drum 1
		2-122-PSV-8 bypass on 2-122-F-2M/U H2 Comp Suction Drum 2
		Block on 2-122-GC-1M/U H2 Comp Dist Piece vent
		Block on 2-122-GC-1M/U H2 Comp Unloader vent
		2-122-PSV-10 bypass on 2-122-GC-1M/U H2 Comp Discharge 1
		2-122-PSV-10 bypass on 2-122-GC-1M/U H2 Comp Discharge 2
		Block on 2-122-GC-1Recycle H2 Comp Dist Piece vent
		Block on 2-122-GC-1Recycle H2 Comp Unloader vent
		2-122-PSV-11 bypass on 2-122-GC-1Recycle H2 Comp Discharge 1
		2-122-PSV-11 bypass on 2-122-GC-1Recycle H2 Comp Discharge 2
		Block on 2-122-GC-2M/U H2 Comp Dist Piece vent
		Block on 2-122-GC-2M/U H2 Comp Unloader vent
		2-122-PSV-12 bypass on 2-122-GC-2M/U H2 Comp Discharge
		Block on 2-122-GC-2Recycle H2 Comp Dist Piece vent
		Block on 2-122-GC-2Recycle H2 Comp Unloader vent
		2-122-PSV-55 bypass on 2-122-GC-2Recycle H2 Comp Discharge 1
		2-122-PSV-55 bypass on 2-122-GC-2Recycle H2 Comp Discharge 2
		2-122-PSV-14 bypass on 2-122-E-6A (T) inletProduct Stripper Bottoms 1
		2-122-PSV-14 bypass on 2-122-E-6A (T) inletProduct Stripper Bottoms 2
		2-122-PSV-57 bypass on 2-122-E-6C (T) inletProduct Stripper Bottoms 1
		2-122-PSV-57 bypass on 2-122-E-6C (T) inletProduct Stripper Bottoms 2
		2-122-PSV-58 bypass on 2-122-E-6C (S) outletProduct Separator to Stripper 1
		2-122-PSV-58 bypass on 2-122-E-6C (S) outletProduct Separator to Stripper 2
		2-122-PSV-56 bypass on 2-122-E-6A (S) outletProduct Separator to Stripper 1
		2-122-PSV-56 bypass on 2-122-E-6A (S) outletProduct Separator to Stripper 2
		2-122-PSV-16 bypass on 2-122-F-4Stripper Ovhd Receiver 1
		2-122-PSV-16 bypass on 2-122-F-4Stripper Ovhd Receiver 2
		2-122-PSV-17 bypass on 2-122-F-5Prod Stripper Btms Coalescer 1
		2-122-PSV-17 bypass on 2-122-F-5Prod Stripper Btms Coalescer 2
		2-122-PSV-20 bypass on 2-122-F-6AProd Strip Btms Salt Dryer 1
		2-122-PSV-20 bypass on 2-122-F-6AProd Strip Btms Salt Dryer 2
		2-122-PSV-21 bypass on 2-122-F-6BProd Strip Btms Salt Dryer 1
		2-122-PSV-21 bypass on 2-122-F-6BProd Strip Btms Salt Dryer 2
		2-122-PSV-24 bypass on 2-122-F-7Fuel Gas KO Drum 1
		2-122-PSV-24 bypass on 2-122-F-7Fuel Gas KO Drum 2
		2-122-PSV-59 bypass on 2-122-F-25AFuel Gas Filter 1
		2-122-PSV-59 bypass on 2-122-F-25AFuel Gas Filter 2
		2-122-PSV-60 bypass on 2-122-F-25BFuel Gas Filter 1
		Block on 1 1/2" line from Kerosene Analyzer Building
		Block on Sample StationFoul Water
		2-122-PSV-60 bypass on 2-122-F-25BFuel Gas Filter 2
	4 Compressor Seals	Compressor Seals 2-122-GC-1 M/U H2 Comp Press Pack vent
		Compressor Seals 2-122-GC-1 Recyc H2 Comp Press Pack vent
		Compressor Seals 2-122-GC-2 M/U H2 Comp Press Pack vent
		Compressor Seals 2-122-GC-2 Recyc H2 Comp Press Pack vent

NNA (Q_S)	Sources	Detailed Source Description
$Q_{(LPVGO)}$ LPVGO Header	18 PSVs	2-103-PSV-78 on 2-103-E-5Reactor Effluent from E-5
		2-103-PSV-79 on 2-103-E-6Reactor Effluent from E-6
		2-103-PSV-49 on 2-103-E-33A/B outletStripper Ovhd line
		2-103-PSV-57 on 2-103-E-17 (S) outletStripper Feed to 2-103-B-3
		2-103-PSV-58 on 2-103-E-21 (S) outletStripper Feed to 2-103-B-3
		2-103-PSV-3 on 2-103-F-4LPFD
		2-103-PSV-7 on 2-103-E-33A/B inletStripper Ovhd line
		2-103-PSV-1 on 2-103-F-1Feed Surge Drum
		2-103-PSV-2 on 2-103-F-2Rx Effluent Separator
		2-103-PSV-29 on 2-103-F-2Rx Effluent Separator
		2-103-PSV-55 on 2-103-D-2Recycle Gas Scrubber
		2-103-PSV-56 on 2-103-F-13Rich Amine Flash Drum
		2-103-PSV-4 on 2-103-GC-1Recycle Hydrogen
		2-103-PSV-32 on 2-103-GC-1Make-up Hydrogen
		2-103-PSV-5 on 2-103-GC-2Recycle Hydrogen
		2-103-PSV-33 on 2-103-GC-2Make-up Hydrogen
		2-103-PSV-34 on 2-103-F-10Make-up H2 Comp Suction Drum
		2-103-PSV-74 on 2-103-GC-1/2 outletHPVGO Recycle Hydrogen
	28 Block Valves	Block on 2-103-E-5 Reactor Effluent from E-5
		Block on 2-103-E-6 Reactor Effluent from E-6
		Bypass 2-103-PSV-57 on 2-103-E-17 (S) outlet Stripper Feed to 2-103-B-3 1
		Bypass 2-103-PSV-57 on 2-103-E-17 (S) outlet Stripper Feed to 2-103-B-3 2
		Bypass 2-103-PSV-3 on 2-103-F-4 LPFD 1
		Bypass 2-103-PSV-3 on 2-103-F-4 LPFD 2
		Block on 2-103-F-6 Stripper Ovhd Rec Off-gas
		Block on 2-103-F-6 High pressure side of PV-18, stripper offgas 1
		Block on 2-103-F-6 High pressure side of PV-18, stripper offgas 2
		Bypass 2-103-PV-9B on 2-103-F-1 Feed Surge Drum
		Bypass 2-103-PSV-2 on 2-103-F-2 Rx Effluent Separator 1
		Bypass 2-103-PSV-2 on 2-103-F-2 Rx Effluent Separator 2
		Bypass 2-103-PSV-29 on 2-103-F-2 Rx Effluent Separator 1
		Bypass 2-103-PSV-29 on 2-103-F-2 Rx Effluent Separator 2
		Bypass 2-103-PSV-55 on 2-103-D-2 Recycle Gas Scrubber 1
		Bypass 2-103-PSV-55 on 2-103-D-2 Recycle Gas Scrubber 2
		Bypass 2-103-PSV-56 on 2-103-F-13 Rich Amine Flash Drum 1
		Bypass 2-103-PSV-56 on 2-103-F-13 Rich Amine Flash Drum 2
		Bypass 2-103-PSV-4 on 2-103-GC-1 Recycle Hydrogen 1
		Bypass 2-103-PSV-4 on 2-103-GC-1 Recycle Hydrogen 2
		Bypass 2-103-PSV-32 on 2-103-GC-1 Make-up Hydrogen 1
		Bypass 2-103-PSV-32 on 2-103-GC-1 Make-up Hydrogen 2
		Bypass 2-103-PSV-5 on 2-103-GC-2 Recycle Hydrogen 1
		Bypass 2-103-PSV-5 on 2-103-GC-2 Recycle Hydrogen 2
		Bypass 2-103-PSV-33 on 2-103-GC-2 Make-up Hydrogen 1
		Bypass 2-103-PSV-33 on 2-103-GC-2 Make-up Hydrogen 2
		Bypass 2-103-PSV-74 on 2-103-GC-1/2 outlet HPVGO Recycle Hydrogen 1
		Bypass 2-103-PSV-74 on 2-103-GC-1/2 outlet HPVGO Recycle Hydrogen 2
	3 Sample Stations	2-103-F-13 Sample Sta Rich Amine Flash Drum Off-gas
		Sample Station Make-up H2 Comp Suction Drum
		Sample Station Recycle H2 Sample Vent
	1 Control Valve	Control Valve 2-103-PV-9B on 2-103-F-1 Feed Surge Drum

NNA (Qs)	Sources	Detailed Source Description
$Q_{(HPH)}$ Hydrogen Plant Header	18 PSVs	2-108-PSV-131 on 2-108-F-1 Net Gas Comp Suction Drum
		2-108-PSV-138 on 2-108-F-9 Net Gas to 2nd Stage G-1A
		2-108-PSV-152 on HPCCR Hydrogen
		2-108-PSV-101 on 2-108-G-1A 1st Stage discharge (H2)
		2-108-PSV-102 on 2-108-G-1A 2nd Stage discharge (H2)
		2-108-PSV-119 on 2-108-G-3A 1st Stage discharge (H2)
		2-108-PSV-120 on 2-108-G-3A 2nd Stage discharge (H2)
		2-108-PSV-139 on 2-108-F-10 Net Gas to 2nd Stage G-3A
		2-108-PSV-154 on 2-108-F-7 Net H2 Comp Suction Drum
		2-108-PSV-103 on 2-108-G-1B 1st Stage discharge (H2)
		2-108-PSV-104 on 2-108-G-1B 2nd Stage discharge (H2)
		2-108-PSV-121 on 2-108-G-3B 1st Stage discharge (H2)
		2-108-PSV-122 on 2-108-G-3B 2nd Stage discharge (H2)
		2-108-PSV-130 on 2-108-F-8 Product Gas KO Drum
		2-108-PSV-117 on 2-108-E-15 (S) inlet H2 spillback to 2-108-F-7
		2-108-PSV-106 on 2-108-DD-2A H2 Chloride Guard Bed
		2-108-PSV-107 on 2-108-DD-2B H2 Chloride Guard Bed
		2-108-PSV-157 on 2-108-F-16 LPCCR Netgas Comp Coalescer
	7 Control Valves	Control Valve 2-108-F-1 on 2-108-LC-132Condensate from suction drums
		Control Valve 2-108-F-7 on 2-108-LC-121Condensate from suction drums
		Control Valve 2-108-F-9 on 2-108-LC-129Condensate from suction drums
		Control Valve 2-108-F-10 on 2-108-LC-131Condensate from suction drums
		Control Valve 2-108-F-8 on 2-108-LC-126Condensate from suction drums
		Control Valve 2-108-F-16 on 2-108-LV-16LPCCR Netgas Comp Coalescer
		Control Valve 2-108-F-16 on 2-108-LV-17LPCCR Netgas Comp Coalescer
	20 Block Valves	Block on 2-108-F-9 Condensate from suction drums LV-129 Bypass
		Block on 2-108-F-1 Condensate from suction drums LV-132 Bypass
		Block on 2-108-G-3B Low point drains
		Block on 2-108-G-3A Low point drains
		Block on 2-108-G-1B Low point drains
		Block on 2-108-G-1A Low point drains
		Block on 2-108-G-1A 1st Stage discharge (H2)
		Block on 2-108-G-1A 2nd Stage discharge (H2)
		Block on 2-108-G-3A 1st Stage discharge (H2)
		Block on 2-108-G-3A 2nd Stage discharge (H2)
		Block on 2-108-F-7 Net H2 Comp Suction Drum PSV-154 Bypass
		Block on 2-108-F-7 Condensate from suction drum LV-121 Bypass
		Block on 2-108-G-1B 1st Stage discharge (H2)
		Block on 2-108-G-1B 2nd Stage discharge (H2)
		Block on 2-108-G-3B 1st Stage discharge (H2)
		Block on 2-108-G-3B 2nd Stage discharge (H2)
		Block on 2-108-F-8 Product Gas KO Drum PSV-117 Bypass
		Block on 2-108-F-16 LPCCR Netgas Comp Coalescer PSV-106 Bypass
		Block on 2-108-F-16 LPCCR Netgas Comp Coalescer PSV-107 Bypass
		Block on 2-108 DD-2A/B H2 in and out of beds
		Block on 2-108-F-16 LPCCR Netgas Comp Coalescer PSV-157 Bypass
		Block on 2-108-F-16 LPCCR Netgas Comp Coalescer LV-16 Bypass
		Block on 2-108-F-16 LPCCR Netgas Comp Coalescer LV-17 Bypass
$Q_{(FW)}$ FW Vent Gas Adsorber	1 PSV	2-24-PSV-98 on 2-24-D-1 FCC FWS

NNA (Q_S)	Sources	Detailed Source Description
$Q_{(FW)}$ FW Vent Gas Adsorber	4 Block Valves	Valves Block on 2-106-F-113 NNA FW Charge Drum
		Bypass Valve 2-106-PSV-163 on 2-106-F-108 Aux FW Surge Drum
		Bypass Valve 2-106-PSV-166 on 2-106-D-104 NNA Aux FWS
		Bypass Valve 2-24-PSV-98 on 2-24-D-1 FCC FWS
$Q_{(C3)}$ Propane Bullet Header	45 PSVs	2-606-PSV-113 Propane from Cavern
		2-606-PSV-115 Propane from Cavern
		2-606-PSV-121 Propane from Cavern
		2-606-PSV-112 Propane from South Area
		2-606-PSV-116 Propane from South Area
		2-606-PSV-122 Propane from South Area
		2-606-PSV-123 Propane to 864 Tank South Area
		2-606-PSV-109 Propane Product Truck Loading Lines
		2-606-PSV-110 Propane Product Truck Loading Lines
		2-606-PSV-124 Propane Product Truck Loading Lines
		2-606-PSV-111 Propane to truck loading/SA 2-606-G-104/105 disch
		2-606-PSV-117 Propane to truck loading/SA 2-606-G-104/105 disch
		2-606-PSV-119 Propane to truck loading/SA 2-606-G-104/105 disch
		2-606-PSV-114 Propane to Sat Gas/Railcar 2-606-G-106/107 disch
		2-606-PSV-118 Propane to Sat Gas/Railcar 2-606-G-106/107 disch
		2-606-PSV-120 Propane to Sat Gas/Railcar 2-606-G-106/107 disch
		2-606-PSV-125 Propane to Sat Gas/Railcar 2-606-G-106/107 disch
		2-66-PSV-50 10" line to AP KOG Fuel Gas Line
		2-606-PSV-126 Propane from Cavern
		2-606-PSV-129 Propane to Tank 862
		2-606-PSV-130 Propane to Tank 862
		2-606-PSV-131 Propane to Tank 862
		2-606-PSV-127 Propane to G-104/105/106/107 from Tank 862
		2-606-PSV-128 Propane to G-104/105/106/107 from Tank 862
		2-606-PSV-423 Propane Tank 862
		2-606-PSV-134 Propane to Tank 863
		2-606-PSV-135 Propane to Tank 863
		2-606-PSV-132 Propane to G-104/105/106/107 from Tank 863
		2-606-PSV-133 Propane to G-104/105/106/107 from Tank 863
		2-606-PSV-424 Propane Tank 863
		2-606-PSV-138 C3/C3=/C4 from SA/Cavern to Tank 864
		2-606-PSV-139 C3/C3=/C4 from SA/Cavern to Tank 864
		2-606-PSV-136 Propane to G-104/105/106/107 from Tank 864
		2-606-PSV-137 Propane to G-104/105/106/107 from Tank 864
		2-606-PSV-106 C3/C3=/C4 from SA/Cavern Tank 864
		2-606-PSV-142 C3/C3=/C4 from SA/Cavern to Tank 865
		2-606-PSV-143 C3/C3=/C4 from SA/Cavern to Tank 865
		2-606-PSV-140 Propane to G-104/105/106/107 from Tank 865
		2-606-PSV-141 Propane to G-104/105/106/107 from Tank 865
		2-606-PSV-107 C3/C3=/C4 from SA/Cavern Tank 865
		2-606-PSV-146 C3/C3=/C4 from SA/Cavern to Tank 866
		2-606-PSV-147 C3/C3=/C4 from SA/Cavern to Tank 866
		2-606-PSV-144 Propane to G-104/105/106/107 from Tank 866
		2-606-PSV-145 Propane to G-104/105/106/107 from Tank 866
		2-606-PSV-108 C3/C3=/C4 from SA/Cavern Tank 866

NNA (Qs)	Sources	Detailed Source Description
Q(C3) Propane Bullet Header	10 Block Valves	Valves Block Propane from Cavern
		Valves Block Propane from South Area
		Valves Block Off-spec Propane Pump vent 2-606-G-106
		Valves Block Off-spec Propane Pump vent 2-606-G-107
		Valves Block 1" vent line from C3 Bullet Manifold
		Valves Block Propane to truck loading/SA 2-606-G-104/105 disch
		Valves Block Propane to Sat Gas/Railcar 2-606-G-106/107 disch
		Valves Block 3" line from Bullet Vent line Manual Vent
		Valves Block 1" drain line to trap #3
		Valves 2-66-PSV-50 bypass 10" line to AP KOG Fuel Gas Line
	2 Pump Seals	Pump Seal 2-606-G-104 Propane Pump & Seal vent
		Pump Seal 2-606-G-105 Propane Pump & Seal vent
Q(SDA) SDA Header	34 PSVs	2-31-PSV-79 on 2-31-E-14 (S) outlet RDC Ovhd
		2-31-PSV-85 on 2-31-E-3 (T) inlet 150 psig steam
		2-31-PSV-88 on 2-31-E-15 (T) inlet Hot Oil
		2-31-PSV-89 on 2-31-E-16 (T) inlet Hot Oil
		2-31-PSV-82 on 2-31-E-1/2 (S) outlet Tempered Water
		2-31-PSV-72 on 2-31-E-4A (S) outlet RDC Ovhd
		2-31-PSV-73 on 2-31-E-4C (S) outlet RDC Ovhd
		2-31-PSV-22 on 2-31-E-10A
		2-31-PSV-21 on 2-31-E-16
		2-31-PSV-71 on on 2-31-F-25
		2-31-PSV-87 on 2-31-E-14 (T) inlet Isom Hot Oil
		2-31-PSV-91 on 2-31-E-32 (S) inlet LP Solvent
		2-31-PSV-112 on 2-31-E-32 (S) outlet LP Solvent to E-3
		2-31-PSV-86 on 2-31-E-10A (T) outlet Tempered Water
		2-31-PSV-90 on 2-31-E-32 (T) inlet 150 psig steam
		2-31-PSV-74 on 2-31-E-4A (T) inlet SDA Charge
		2-31-PSV-75 on 2-31-E-4C (T) inlet SDA Charge
		2-31-PSV-67 on 2-31-E-30 (S) outlet Ram Oil
		2-31-PSV-69 on 2-31-E-31 (S) outlet Flush Oil
		2-31-PSV-68 on 2-31-E-30 (S) outlet Ram Oil
		2-31-PSV-81 on 2-31-B-2 outlet SDA Hot Oil Heater
		2-31-PSV-6 on 2-31-F-1 LP Solvent Surge Drum
		2-31-PSV-2 on 2-31-D-1 No. 1 RDC Tower Ovhd
		2-31-PSV-110 on 2-31-D-1 No. 1 RDC Tower Ovhd
		2-31-PSV-3 on 2-31-D-2 No. 2 RDC Tower Ovhd
		2-31-PSV-4 on 2-31-D-2 No. 2 RDC Tower Ovhd
		2-31-PSV-139 on 2-31-E-5A/C (T) inlet Solvent from HP Flash Tower
		2-31-PSV-147 on 2-31-D-5 DAO Stripper Ovhd
		2-31-PSV-40 on 2-31-F-4 Solvent Comp Suction Drum
		2-31-PSV-84 on 2-31-F-2 HP Solvent Surge Drum
		2-31-PSV-76 on 2-31-D-6 Asphalt Flash Tower Ovhd
		2-31-PSV-144 on 2-31-D-7 Asphalt Stripper Ovhd
		2-66-PSV-18 on 2-66-F-3 SDA Fuel Gas Drum
		2-31-PSV-71 on 2-31-GC-17 2nd Stage Solvent
		2-31-PSV-80 on 2-31-B-2 outlet SDA Hot Oil Heater
		2-31-PSV-41 on 2-31-GC-17 2nd Stage Solvent
		2-31-PSV-111 on 2-31-GC-17 2nd Stage Solvent

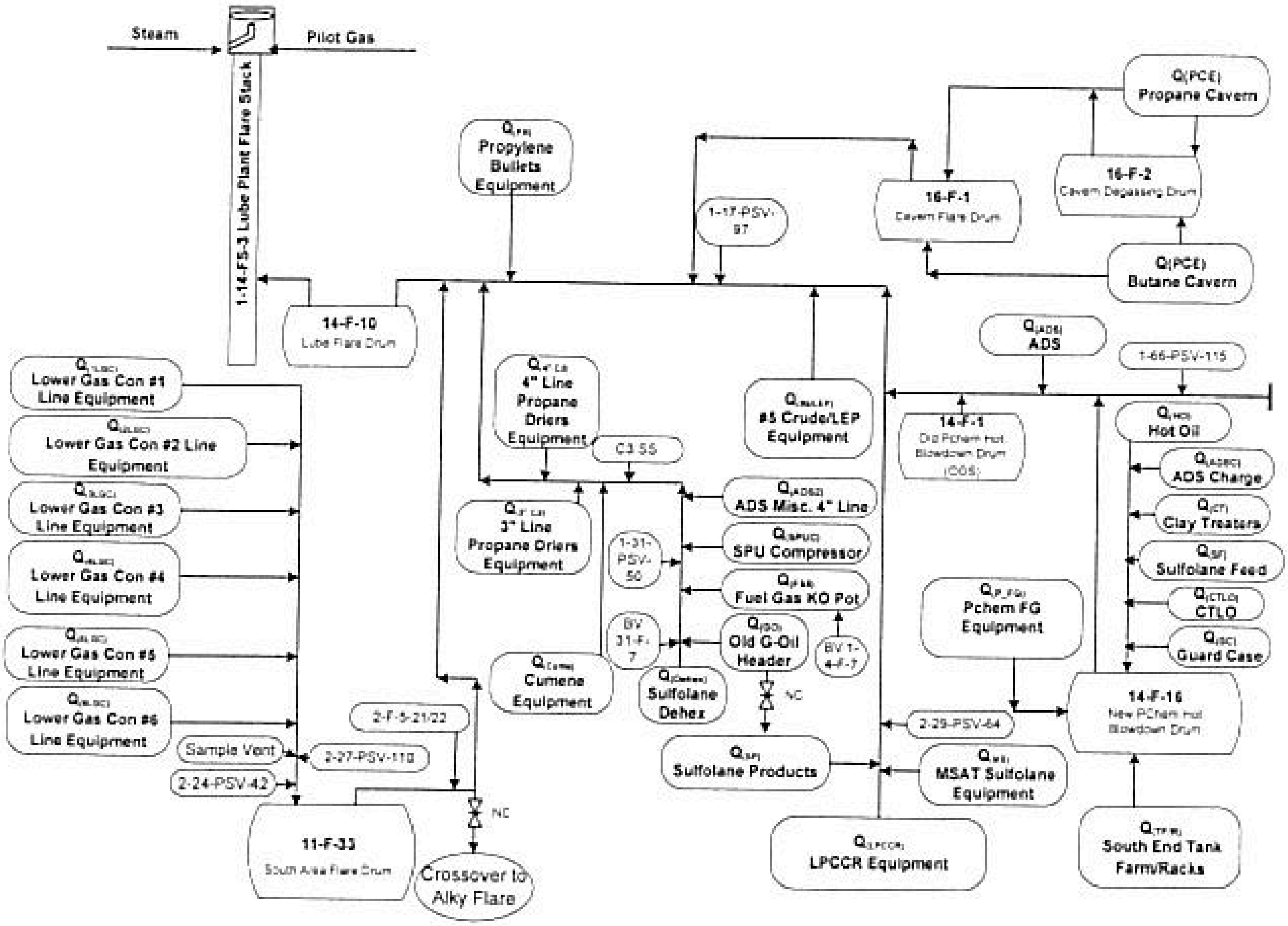
NNA (Q_s)	Sources	Detailed Source Description
$Q_{(SDA)}$ SDA Header	52 Block Valves	Bypass Valve 2-31-PSV-82 on 2-31-E-1/2 (S) outlet Tempered Water
		Valves Block on 2-31-D-1 No. 1 RDC Tower Bottoms Drain
		Valves Block on 2-31-D-2 No. 2 RDC Tower Bottoms Drain
		Valves Block on 2-31-G-3 LP/HP Pump vents
		Valves Block on 2-31-G-4 LP/HP Pump vents
		Valves Block on 2-31-G-5 LP/HP Pump vents
		Valves Block on 2-31-G-6 LP/HP Pump vents
		Valves Block on 2-31-G-25 LP/HP Pump vents
		Valves Block on 2-31-D-7 Asphalt Stripper Bottoms
		Valves Block on 2-31-B-1 outlet Asphalt Mix Heater
		Valves Block on 2-31-D-6 Asphalt Flash Tower Bottoms Drain
		Valves Block on 2-31-F-1/2 LP/HP Solvent Surge Drums Drain
		Valves Block on 2-31-F-4 Solvent Comp Suction Drum Drain
		Valves Block on 2-31-G-70/71 Solvent Condensate Pump Discharge Drain
		Valves Block on 2-31-E-25 Stripping Steam Condener Drain
		Valves Block on 2-31-E-15/16 (S) inlet Asphalt Mix Preheat Exchangers In & Out
		Valves Block on 2-31-E-15/16 (S) outlet Asphalt Mix Preheat Exchangers In & Out
		Valves Block on 2-31-G-59/60 Asphalt Product Pumps
		Valves Block on 2-31-G-5 Pump seal vents
		Valves Block on 2-31-G-6 Pump seal vents
		Valves Block on 2-31-G-61/62 LCO flush to suction line
		Valves Block on 2-31-G-61/62 Ram Oil to suction line
		Valves Block on LCO Flush to traced flare hdr 2" line from LCO Flush
		Valves Block on 2-31-E-6 1 1/2" drain line form 31-E-6
		Valves Block on Ram Oil to Pitch Drain 2" line from Ram Oil connections
		Valves Block on 2-31-G-59 Pump seal vents
		Valves Block on 2-31-G-60 Pump seal vents
		Valves Block on 2-31-G-3 Pump seal vents
		Valves Block on 2-31-G-4 Pump seal vents
		Valves Block on 2-31-G-25 Pump seal vents
		Valves Block on Sampler System LP Solvent Surge Drum
		Valves Block on 2-31-F-1 LP Solvent Surge Drum PSV-6 Tailpipe
		Valves Block on 2-31-J-2 Evacuation jet outlet
		Bypass Valve 2-31-PSV-2 on 2-31-D-1 No. 1 RDC Tower Ovhd
		Bypass Valve 2-31-PSV-110 on 2-31-D-1 No. 1 RDC Tower Ovhd
		Bypass Valve 2-31-PSV-3 on 2-31-D-2 No. 2 RDC Tower Ovhd
		Bypass Valve 2-31-PSV-4 on 2-31-D-2 No. 2 RDC Tower Ovhd
		Bypass Valve 2-31-PSV-147 on 2-31-D-5 DAO Stripper Ovhd
		Bypass Valves 2-31-PSV-40 on 2-31-F-4 Solvent Comp Suction Drum 1
		Bypass Valves 2-31-PSV-40 on 2-31-F-4 Solvent Comp Suction Drum 2
		Bypass Valves 2-31-PSV-84 on 2-31-F-2 HP Solvent Surge Drum 1
		Bypass Valves 2-31-PSV-84 on 2-31-F-2 HP Solvent Surge Drum 2
		Bypass Valve 2-31-PSV-84 on 2-31-F-2 HP Solvent Surge Drum
		Bypass Valve 2-31-PSV-76 on 2-31-D-6 Asphalt Flash Tower Ovhd
		Valves Block on 2-31-F-4 Solvent Comp Suction Drum
		Valves Block on 2-66-F-3 SDA Fuel Gas Drum (top)
		Valves Block on 2-66-F-3 SDA Fuel Gas Drum (bottom)
		Valves Block on 2-66-F-3 SDA Fuel Gas Drum Vent
		Valves Block on 2-31-D-6 to E-10A/28 Asphalt Flash Tower Ovhd
		Valves Block on 2-31-GC-17 Compressor Vents
		Block Valve for Compressor Seal 2-31-GC-17 Bearing Vents
	1 Pressur Control Valve	Control Valve 2-31-HV-5 on 2-31-F-4 Solvent Comp Suction Drum

NNA (Qs)	Sources	Detailed Source Description
Q(SDA) SDA Header	1 Compressor Seal	Compressor Seals 2-31-GC-17 Bearing Vents
Q(12kds) 12" KDS Header	6 PSVs Valves	2-122-PSV-13 on 2-122-D-2 Product Stripper
		2-122-PSV-20 on 2-122-F-6A Prod Strip Btms Salt Dryer
		2-122-PSV-21 on 2-122-F-6B Prod Strip Btms Salt Dryer
		2-122-PSV-24 on 2-122-F-7 Fuel Gas KO Drum
		2-122-PSV-59 on 2-122-F-25A Fuel Gas Filter
		2-122-PSV-60 on 2-122-F-25B Fuel Gas Filter
	3 Block Valves	Block on 2-122-F-7Fuel Gas KO Drum
		Block on 2-122-F-25AFuel Gas Filter
		Block on 2-122-F-25BFuel Gas Filter
Q(Deb) Debut Rundown	2 PSVs	2-102-PSV-104 on Reformate rundown Debutanizer bottoms
		2-102-PSV-105 on Reformate rundown Debutanizer bottoms
Q(npt R) NPT Rundown	3 PSVs	2-101-PSV-106 on 2-101-G-2A/B inlet Naptha Charge Pumps
		2-101-PSV-107 on 2-101-E-7A/B outlet Naptha to Storage
		2-101-PSV-105 on 2-101-E-7A/B outlet Stripper Ohvd. Liquid to Sat Gas

Flare Flow	Flow Estimate (scfd)	Basis For Estimate
Q(#3) #3 Crude Relief Header	110,000	Estimate base on Flow indication
Q(DDS) DDS Header	90,000	Estimate base on Flow indication
Q(2SRU) #2 SRU Header	93,000	Estimate base on Flow indication
Q(HPCCR) HPCCR Header	757,000	Tracerco
Q(NPT) NPT Flare Header	131,290	Tracerco
Q(HPVGO) HPVGO Flare Header	374,325	Tracerco
Q(ISOM) ISOM Header	363,617	Tracerco
Q(18kds) 18" KDS Header	46,890	Tracerco
Q(12kds) 12" KDS Header	25,000	Estimate base on flow indication
Q(LPVGO) LPVGO Header	183,180	Tracerco
Q(HPH) Hydrogen Plant Header	35,000	Estimate based on flow indication
Q(1SRU) #1 SRU Header	77,000	Estimate base on flow indication
Q(FW) FW Vent Gas Adsorber	1,000	AP-42 Equipment Leak Emission Factors
Q(C3) Propane Bullet Header	31,150	Tracerco
Q(SDA) SDA Header	296,765	Tracerco
Debut Rundown	1,000	AP-42 Equipment Leak Emission Factors
NPT Rundown	1,000	AP-42 Equipment Leak Emission Factors

Appendix D

Lube Flare Waste Gas Flows


Steam
Pilot Gas
1-14-FS-3 Lube Plant Flare Stack
14-F-10
Lube Flare Drum
Propylene Bullets Equipment
1-17-PSV-97
16-F-1
Cavern Flare Drum
Q(PCE)
Propane Cavern
16-F-2
Cavern Degassing Drum
Q(PCE)
Butane Cavern
ADS
1-66-PSV-115
Lower Gas Con #1 Line Equipment
Lower Gas Con #2 Line Equipment
Lower Gas Con #3 Line Equipment
Lower Gas Con #4 Line Equipment
Lower Gas Con #5 Line Equipment
Lower Gas Con #6 Line Equipment
4" Line Propane Driers Equipment
C3 SS
3" Line Propane Driers Equipment
#5 Crude/LEP Equipment
14-F-1
Old Pchem Hot Blowdown Drum
(OOS)
Hot Oil
ADS Charge
Clay Treaters
Sulfolane Feed
CTLO
Guard Case
ADS Misc. 4" Line
SPU Compressor
Fuel Gas KO Pot
Old G-Oil Header
BV 1-4-F-7
1-31-PSV-50
BV 31-F-7
Cumene Equipment
Sulfolane Dehex
NC
Pchem FG Equipment
14-F-16
New PChem Hot Blowdown Drum
2-29-PSV-64
MSAT Sulfolane Equipment
Sulfolane Products
Sample Vent
2-27-PSV-110
2-24-PSV-42
2-F-5-21/22
11-F-33
South Area Flare Drum
Crossover to Alky Flare
LPCCR Equipment
South End Tank Farm/Racks

Lube (Qs)	Sources	Detailed Source Description
$Q_{(PCE)}$ Propane Cavern Equipment	8 PSVs	1-16-PSV-11 on Propane Rundown Meter #11
		1-16-PSV-10 on Propane Rundown Meter #12
		1-16-PSV-9 on Propane Rundown Meter #12
		1-16-PSV-8 on Propane Rundown Meter #12
		1-16-PSV-12 on Propane Rundown Meter #22
		1-16-PSV-13 on Propane Rundown Meter #22
		1-16-PSV-14 on Propane Rundown Meter #22
		1-16-PSV-15 on Propane Rundown Meter #21
	6 Block Valves	Block Valve on 1-16-F-11/12 Meter Strainers 1-16-F-11/12
		Block Valve on 1-16-F-21/22 Meter Straner 1-16-F-21/22
		Block Valve on 1-16-G-1 1-16-G-1 Cavern Pump Drain Line
		Block Valves on Proper Loop
		Block Valve on Meter #3 - Cavern Recirculaton Line
		Block Valve on 1-16-G-2 1-16-G-2 Cavern Pump Drain Line
	1 Control Valve	1-16-PV-3 on Propane Cavern Vapor vent line
$Q_{(PCE)}$ Butane Cavern	2 PSVs	1-23-PSV-1 on Cavern Vapor Space Relief
		1-23-PSV-12 on Metering Return Line Relief
	5 Block Valves	Block Valve on 1-23-G-1 Butane Cavern Pump Drain
		Block Valve on 1-23-G-2 Butane Cavern Pump Drain
		Block Valve on Cavern Vapor Space Relief PSV 1 4" Block bypass
		Block Valve on Cavern Vapor Space Relief PSV 1 4" Block bypass
		Block Valve on Butane Strainers 1-23-S-1/2 Drain Line
$Q_{(P\_FG)}$ Pchem FG Equipment	6 PSVs	1-66-PSV-8 on 1-66-F-16 Petrochem Fuel Gas Drum
		1-66-PSV-9 on 1-28-F-30 ADS Fuel Drum KO Pot
		1-66-PSV-61 on 1-31-F-7 Fuel Gas Drum
		1-66-PSV-10 on 1-31-F-55 SHU Charge Htr FG KO Pot
		1-31-PSV-36 on 1-33-F-55 Hot Oil Htrs FG KO Drum
		1-66-PSV-1 on 1-66-D-1 FG Scrubber Off-gas line
	5 Block Valves	Block on 1-66-F-16 Sampler Petrochem Fuel Gas Drum
		Block on 1-28-F-30 ADS Fuel Drum KO Pot
		Block on 1-31-F-7 FG KO Pot Bot drain
		Block on 1-31-F-55 SHU Charge Htr FG KO Pot
		Block on 1-33-F-55 Hot Oil Htrs FG KO Drum
	2 Control Valves	1-66-LV-2 on 1-66-F-1 Sour Fuel Gas KO Pot liquid
		1-66-LV-6 on 1-66-F-16 Petrochem FG Drum liquid
$Q_{(ADSC)}$ ADS Charge	5 PSVs	1-28-PSV-4 on 1-28-F-1 Reactor Charge Drum
		1-28-PSV-46 on 1-28-E-35 (T) inlet Reactor Charge
		1-28-PSV-6 on 1-28-F-4 LPFD
		1-28-PSV-5 on 1-28-B-1 Conv Sec Hot Oil
		1-28-PSV-20 on 1-28-F-4A LPFD Water Boot
	2 Pressure Control Vavles	Pressure Control Valve on 1-28-F-1 Reactor Charge Drum 28-PV-2A
		Pressure Control Valve on 1-28-F-1 Reactor Charge Drum 28-PV-2B
	1 Pump Seals	Pump Seals on 1-28-G-35 ADS Charge Pump - Seal Pot

Lube (Qs)	Sources	Detailed Source Description
$Q_{(ADS)}$ ADS	9 PSVs	1-28-PSV-27 on 1-28-D-10 No. 1 Tower Ovhd line
		1-28-PSV-10 on 1-28-GC-10 Make-up Hydrogen to Rx's
		1-28-PSV-7 on 1-28-F-2 Recycle Hydrogen
		1-28-PSV-8 on 1-28-F-6 Make-up Hydrogen
		1-28-PSV-48 on 1-28-F-4 LPFD
		1-28-PSV-9 on 1-28-GC-11 Recycle Hydrogen
		1-28-PSV-28 on 1-28-GC-44 Make-up Hydrogen
		1-28-PSV-29 on 1-28-GC-43 Recycle Hydrogen
		1-28-PSV-13 on 1-28-F-17 Tower Ovhd line
	15 Block Valves	Block on Tank 194 or 64 Bz or Tol to Rx Charge Drum
		Block on Sour H2 Sampler Sour Hydrogen
		Block on 1-28-F-15 No. 1 Ovhd Acc OG Sampler
		Block on 1-28-GC-10 Compressor vents
		Block on 1-28-G-42 Pump vent line
		Block on 1-28-G-96 Pump vent line
		Block on 1-28-F-21 Foul Water Acc
		Block on 1-35-G-18 Pump vent line
		Block on 1-35-G-19 Pump vent line
		Block on 1-28-G-31 Pump vent line
		Block on 1-35-G-63 Pump vent line
		Block on 1-35-G-38 Pump vent line
		Block Valve on 1-28-D-2/3 ADS Reactor Evac Jet
		Block Valve on 1-28-F-3/4 ADS HPFD / LPFD
		Block Valve on 1-28-F-1 Reactor Charge Drum 1" bypass around PCVs
	2 Control Valves	1-28-PV-3B on 1-28-F-3 HPFD Off-gas to Sour Gas Pot
		1-28-PV-4 on 1-28-F-4 LPFD Off-gas to Sour Gas Pot
	2 Pump Seals	RO Vents on 1-28-G-29 #1 Tower Pumps G-29 Seal Pot
		RO Vents on 1-28-G-30 #1 Tower Pumps G-30 Seal Pot
	2 Sample Stations	
	2 Compressor Seals	Compressor Seals on 1-28-GC-10/11 Recycle Compressors
$Q_{(ADS2)}$ ADS Misc.	4 Block Valves	1-28-FV-15 on #1 Tower Overhead Acc.
		Block on 1-28-F-2/6/14 bottom Liquid drain to Sour Gas Pot
		Valve Block Valve on Flare Drop near 28-E-42A
		Block on 1-28-G-14 Evac jet from ADS Rx & 1-28-F-2, G-10/43
		Block on 1-28-G-43/44 Yoke vent to Sour Gas Pot
	3 PSVs	1-28-PSV-39 on 1-28-E-31 (S) inlet LPFD Liquid to No. 1 Tower
		1-28-PSV-40 on 1-28-E-31 (S) outlet LPFD Liquid to No. 1 Tower
		1-28-PSV-44 on 1-28-F-21
		1-28-PSV-34 on 1-28-E-9 (T) outlet Rx Eff to1-28-E-10A (S) inlet
$Q_{(CTLO)}$ CTLO	3 PSVs	1-29-PSV-70 on 1-29-E-53 (T) outlet CTLO Splitter Btms Reboiler
		1-29-PSV-101 on 1-29-E-54 (T) inlet CTLO Splitter Side Reboiler
		1-29-PSV-99 on 29 E-53 CTLO Reboiler
	3 Block Valves	Block Bypass 1-29-PSV-111 on 1-29-F-57B CTLO Split Ovhd Water Bottle PSV-111 1"
		Open Block on 1-29-F-2 CTLO Split Ovhd Seal Pot
		Block Valve on 1-29-F-1 CTLO Feed Filter Vent

Lube (Q_s)	Sources	Detailed Source Description
Q (GC) Guard Case	9 PSVs	1-4-PSV-17 on 1-4-E-22 (S) inlet Preflash Liq to Prefractionator
		1-4-PSV-22 on 1-4-D-5 inlet Guard Case Rx Feed
		1-4-PSV-34 on 1-4-D-5 inlet Guard Case Rx Feed
		1-4-PSV-19 on 1-4-F-7 Preflash Drum
		1-4-PSV-21 on 1-4-D-6 Prefractionator Ovhd line
		1-4-PSV-42 on 1-4-FF-17 Guard Case Feed Filter
		1-4-PSV-16 on 1-4-E-28 inlet SPU H2 from HPFD
		1-4-PSV-101 on 4-E-18 Guard Case Feed Exchanger
		1-4-PSV-102 on 4-E-18 Guard Case Feed Exchanger
	6 Block Valves	Valves Block on 1-4-J-10 Evacuation Jet
		Valves Block on 1-4-F-8 Pref Ovhd Acc
		Valve Block Valve on 1-29-F-8 Guard Case Fuel Gas Drum PSV 90 2" Block Bypass
		Valve Sample Station on 4-F-8 Prefractionator OVHD Accumulator - Sample
		Valve Block Valve on 1-4-FF-17 Guard Case Feed Filter PSV-42 1" Block Bypass
		Valve BlockValve on 1-4-FF-18 Guard Case Feed Filter PSV-43 1" Block Bypass
Q (CT) Clay Treaters	6 PSVs	1-29-PSV-976 on 1-29-E-79
		1-29-PSV-975 on 1-29-F-18 Clay Treater
		1-27-PSV-974 on 1-27-D-7 Clay Treater
		1-45-PSV-41 on 1-45-D-15 #1 Sol Tower OVHD Line
		1-66-PSV-61 on 1-31-F-7 Fuel Gas Drum
		1-29-PSV-111 on 1-29-F-57B CTLO Split Ovhd Water Bottle
	2 Block Valves	Valves Block on 1-29-F-18 Clay Treater Btm Drain
		Valves Block on 1-27-D-7 Clay Treater Btm Drain
$Q_{(HO)}$ Hot Oil	1 PSV	1-4-PSV-90 on 1-29-F-8 Guard Case Fuel Gas Drum
	1 Block Valve	Block on 1-33-F-55 Hot Oil Htrs FG KO Drum
	1 Pump Seals	Pump Seals on 1-29-G-1 Hot Oil Pump - Seal Pot
$Q_{(Dehex)}$ Sulfolane Dehezanizer	6 PSVs	1-33-PSV-52 on 1-33-F-51 SHU Hydrogen Compressor Suction Drum
		1-33-PSV-53 on 1-33-GC-51 SHU Hydrogen Compressor
		1-33-PSV-1 on 1-33-F-1 SHU Sweet Hydrogen Suction Drum
		1-33-PSV-2 on 1-33-GC-1 SHU Sweet Make-Up Hydrogen Compressor
		1-27-PSV-76 on 1-29-D-13 Reformate Dehexanizer
		1-27-PSV-79 on 1-27-F-44 Reform Dehex Ovhd Acc
$Q_{(GO)}$ Old G-Oil Header	3 PSVs	1-27-PSV-89 on 1-27-F-55 outlet Lean Solvent
		1-4-PSV-43 on 1-4-FF-18 Guard Case Feed Filter
		1-27-PSV-80 on 1-27-F-1 Splitter Ovhd Rec
$Q_{(F55)}$ Fuel Gas KO Pot	2 PSVs	1-66-PSV-10 on 1-31-F-55 SHU Charge Htr FG KO Pot
		1-31-PSV-36 on 1-33-F-55 Hot Oil Htrs FG KO Drum
	4 Block Valves	Valves Block on 1-31-F-7 FG KO Pot Bot drain
		Valves Block on 1-31-F-55 SHU Charge Htr FG KO Pot
		Block on 1-31-F-55 SHU Charge Htr FG KO Pot
		Valves Block on 1-33-F-55 Hot Oil Htrs FG KO Drum

Lube (Qs)	Sources	Detailed Source Description
$Q_{(LPCCR)}$ **LPCCR Equipment**	27 PSVs	1-44-PSV-74 on 1-44-E-1 (S) outlet Purge Gas from 44-G-1
		1-44-PSV-1 on 1-44-F-1 Separator
		1-44-PSV-2 on 1-44-F-1 Separator
		1-44-PSV-3 on 1-44-F-1 Separator
		1-44-PSV-5 on 1-44-GC-1 outlet Recycle Gas Compressor
		1-44-PSV-73 on 1-44-GC-1 outlet Recycle Gas Compressor
		1-44-PSV-7 on 1-44-F-2 Recontact Drum
		1-44-PSV-8 on 1-44-F-3 Net Gas Chloride Treater
		1-44-PSV-18 on 1-44-F-7 Net Gas Chloride Treater
		1-44-PSV-88 on 1-44-F-67 inlet Reduction Gas
		1-44-PSV-9 on 1-44-D-5 Debutanizer
		1-44-PSV-10 on 1-44-F-40 Debut Ovhd Chloride Treater
		1-44-PSV-12 on 1-44-F-5 Debut Ovhd Rec
		1-44-PSV-16 on 1-44-E-6D (S) outlet Debutanizer feed
		1-44-PSV-15 on 1-44-E-6C (S) outlet Debutanizer feed
		1-44-PSV-14 on 1-44-E-6B (S) outlet Debutanizer feed
		1-44-PSV-13 on 1-44-E-6A (S) outlet Debutanizer feed
		1-44-PSV-22 on 1-44-F-9 LPCCR Fuel Gas Drum
		1-44-PSV-51 on 1-44-F-41 Net Gas Comp 1st Stage Suction Drum
		1-44-PSV-52 on 1-44-F-42 Net Gas Comp Interstage Drum
		1-44-PSV-55 on 1-44-G-18 (2nd Stage) Discharge to SPU/spillback
		1-44-PSV-54 on 1-44-G-18 (1st Stage) Discharge to 44-F-41
		1-44-PSV-32 on 1-44-F-13 Lock Hopper No. 1
		1-44-PSV-40 on 1-44-F-19 Lift Engager No. 2
		1-44-PSV-39 on 1-44-F-18 Lock Hopper No. 2
		1-44-PSV-43 on 1-44-F-33 Recycle Gas Coalescer
		1-44-PSV-46 on 1-44-F-34 Booster Gas Coalescer
	5 Pump Seals	Open vents RO-8/9 on 1-44-F-43/44 Sep Pumps (G-4/5) res vents
		Open vents RO-11/12 on 1-44-F-45/46 Recon Pumps (G-4/5) res vents
		Open vents RO-22/23 on 1-44-F-47/48 Debut Reboiler Pumps (G-8/10) res vents
		Open vents RO-15/16 on 1-44-F-49/50 Debut Ovhd Pumps (G-11/12) res vents
		Pump seals on 44-G-6/7
	2 Vents	RO-403 on Vent/Lock Hoppers Recycle Gas
		RO-442 on Lift/Lock Hoppers Booster Gas
	5 Sample Stations	Valves Block on Sample System Chlorided Reduction Gas
		Valves Block on Sample System Net Gas
		Valves Block on Analyzer Bldg Vent Analyzer Sample Vent
		Valve Sample Station on Recycle Hydrogen Sample Vent (SAM 334)
		Sample Station Booster Hydrogen Sample Vent
	1 Control Valve	Control Valve 1-44-PV-38B on 1-44-F-1 Separator Off-Gas to 44-G-1

Lube (Qs)	Sources	Detailed Source Description
$Q_{(LPCCR)}$ **LPCCR Equipment**	27 Block Valves	Valves Block on 1-44-E-1 (T) inlet No. 4 Reactor Product Btm
		Valves Block on 1-44-G-18 Net Gas Comp vent gas
		Valves Block on 1-44-GC-1 inlet Recycle Gas Compressor
		Valves Block on 1-44-J-1 Jet Ejector System
		Valves Block on 1-44-F-67 Red Gas Chloride Treater
		Valves Block on 1-44-F-49/50 Debut Ovhd Pumps (G-11/12) discharge
		Valves Block on 1-44-F-5 Debut Ovhd Rec Off-gas
		Valves Block on 1-44-F-9 LPCCR Fuel Gas Drum Btm
		Valves Block on 1-44-F-18 Lock Hopper No. 2
		Valves Block on 1-44-F-34 Btm outlet Booster Gas Coalescer
		Valve Pump Seals on 44-G-6/7 Re-Contact Liquid Pumps - Seal Pots
		Valve Sample Station on Booster Hydrogen Sample Vent
		Valve Block Valve on 1-44-F-2 Recontact Drum 44-PSV-7 1.5" block bypass
		Valve Block Valve on 1-44-F-3 Net Gas Chloride Treater 44-PSV-8 1..5" block bypass
		Valve Block Valve on 1-44-F-67 inlet Reduction Gas 44-PSV-88 1.5" block bypass
		Valve Block Valve on 1-44-G-18 (2nd Stage) Discharge to SPU/spillback 44-PSV-55 1.5" block bypass
		Valve Block Valve on 1-44-G-18 (1st Stage) Discharge to 44-F-41 44-PSV-54 1/5" block bypass
		Valve Block Valve on 1-44-F-41 Net Gas Comp 1st Stage Suction Drum 44-PSV-51 1.5" block bypass
		Valve Block Valve on 1-44-F-42 Net Gas Comp Interstage Drum 44-PSV-52 1.5" block bypass
		Valve Block Valve on 1-44-F-7 Net Gas Chloride Treater 44-PSV-18 3" block bypass
		Valve Block Valve on 1-44-D-5 Debutanizer 44-PSV-9 1.5" block bypass
		Valve Block Valve on 1-44-F-40 Debut Ovhd Chloride Treater 44-PSV-10 1.5" block bypass
		Valve Block Valve on 1-44-F-9 LPCCR Fuel Gas Drum 44-PSV-22 1.5" block bypass
		Valve Block Valve on 1-44-F-33 Recycle Gas Coalescer 44-PSV-43 1.5" block bypass
		Valve Block Valve on 1-44-E-1 (S) outlet Purge Gas from 44-G-1 4-PSV-74 1" block bypass
		Valve Block Valve on 1-44-F-19 Lift Engager No. 2 44-PSV-40 1.5" block bypass
		Valve Block Valve on 1-44-F-1 Separator 44-PSV-3 1.5" block bypass
(Q_{SPUC}) **SPU Compressor**	3 PSVs	1-31-PSV-48 on 1-31-GC-1 SPU Hydrogen Compressor
		1-31-PSV-51 on 1-31-GC-1 SPU Hydrogen Compressor
		1-31-PSV-47 on 1-31-F-4 SPU Hydrogen Compressor KO Pot
	1 Compressor Seal	Compressor Seal on 1-31-GC-1 SPU Hydrogen Compressor
	1 Block Valve	Block on 1-31-F-7 FG KO Pot Bot drain

Lube (Qs)	Sources	Detailed Source Description
$Q_{(Cume)}$ Cumene Equipment	47 PSVs	1-35-PSV-2 on 1-35-F-2 C3/C3' Combined Charge
		1-35-PSV-43 on 1-35-D-2 Feed to No. 1 Reactor
		1-35-PSV-7 on 1-35-D-2 Feed to No. 1 Reactor
		1-35-PSV-6 on 1-35-D-2 No. 1 Reactor
		1-35-PSV-9 on 1-35-F-5 outlet No. 1 Reactor Product Cat Filter Pot
		1-35-PSV-10 on 1-35-F-6 outlet No. 2 Reactor Product Cat Filter Pot
		1-35-PSV-82 on 1-35-D-4 No.1 Rectifier ovh to Deprop
		1-35-PSV-121 on 1-35-E-41 outlet C3/C3' Charge to 1-35-E-7/8
		1-35-PSV-49 on 1-35-F-7 Depropanizer Ovhd Rec
		1-35-PSV-89 on 1-35-D-5 Deprop Ovhd to 1-35-E-12's
		1-35-PSV-88 on 1-35-F-42 outlet Bz Col Bottoms KO Pot
		1-35-PSV-12 on 1-35-D-6 Overhead Bz Col Ovhd to 1-35-E-13's
		1-35-PSV-13 on 1-35-D-6 Overhead Bz Col Ovhd to 1-35-E-13's
		1-35-PSV-14 on 1-35-D-6 Overhead Bz Col Ovhd to 1-35-E-13's
		1-35-PSV-15 on 1-35-D-6 Overhead Bz Col Ovhd to 1-35-E-13's
		1-35-PSV-80 on 1-35-F-8 Bz Col Ovhd Rec
		1-35-PSV-70 on 1-35-D-17 No. 1 Rectifier Ovhd to E-47
		1-35-PSV-73 on 1-35-F-35 No. 1 Cumene Bot H20 Wash
		1-35-PSV-75 on 1-35-D-8 Clay Treater
		1-35-PSV-76 on 1-35-D-9 Clay treater
		1-7-PSV-9 on Tank 91 C3/C3' Combined Charge
		1-35-PSV-90 on 1-35-T-91/92 C3/C3' Combined Charge
		1-35-PSV-115 on 1-35-T-91/92 C3/C3' Combined Charge
		1-35-PSV-66 on 1-35-D-15 inlet Feed to No. 3 Reactor
		1-35-PSV-68 on 1-35-D-15 outlet No 3 Reactor
		1-35-PSV-69A on 1-35-F-29 outlet No. 3 Reactor Product Cat Filter Pot
		1-35-PSV-74 on 1-35-D-16 No. 2 Cumene Col Ovhd Line
		1-35-PSV-114 on 1-35-F-34 No. 2 Cumene Col Ovhd Rec
		1-35-PSV-44 on 1-35-D-3 Feed to No. 2 Reactor
		1-35-PSV-8 on 1-35-D-3 Feed to No. 2 Reactor
		1-35-PSV-5 on 1-35-D-3 No. 2 Reactor
		1-35-PSV-75 on 1-35-D-8 Clay Treater
		1-35-PSV-76 on 1-35-D-9 Clay Treater
		1-35-PSV-91 on 1-35-D-18 Bz Col Bot Clay Treater
		1-35-PSV-92 on 1-35-D-19 Bz Col Bot Clay Treater
		1-35-PSV-93 on 1-35-F-50 Bz Col Bot Clay Treater Eff Filter Pot
		1-35-PSV-94 on 1-35-F-51 Bz Col Bot Clay Treater Eff Filter Pot
		1-35-PSV-111 on 1-35-E-48A (S) inlet Bz Col Bot Clay Treater Eff Filter Pot
		1-35-PSV-112 on 1-35-E-48A (T) outlet Bz Col Bot E-48C
		1-35-PSV-95 on 1-35-D-20 No. 1 Cumene Col Ovhd Line
		1-35-PSV-96 on 1-35-D-20 No. 1 Cumene Col Ovhd Line
		1-35-PSV-97 on 1-35-D-20 No. 1 Cumene Col Ovhd Line
		1-35-PSV-71 on 1-35-F-33 No. 2 Rect Ovhd Rec
		1-35-PSV-107 on 1-35-D-21 Propane KOH Treater outlet
		1-35-PSV-108 on 1-35-D-22 Propane KOH Treater outlet
		1-35-PSV-109 on 1-35-E-56 (S) inlet Propane KOH Treater outlet
		1-35-PSV-98 on 1-35-F-46 No. 1 Cumene Ovhd Rec

Lube (Qs)	Sources	Detailed Source Description
$Q_{(Cume)}$ Cumene Equipment	35 Block Valves	Block Valve on 1-35-J-25 Ejector from 1-35-D-2
		Block Valve on 1-35-F-6 inlet No. 2 Reactor Product Cat Filter Pot
		Block Valve on 1-35-J-4 Ejector from 1-35-D-15
		Block Valve on 1-35-F-34 No. 2 Cumene Col Ovhd Rec
		Block Valve on 1-35-D-18/19 outlet Bz Col Bot Clay Treater
		Block Valve on 1-35-D-21/22 Bottom Outlet to flare
		Block Valve on 1-35-F-15/F-7 Depressure Line to flare
		Block Valve Valve on 4" line - Flare Drop
		Block Valve Valve on 1-35-F-42 35-F-42 PSV88 1" block bypass
		Block Valve Valve on 1-35-F-33 35-F-33 PSV71 1" block bypass
		Block Valve Valve on 1-35-F-33 PV-53C near 35-F-33 2" block bypass
		Block Valve Valve on 1-35-D-17 Recifier PSV70 6" block bypass
		Block Valve Valve on 1-35-D-13/14 25-D-13/14 PSV61 1" block bypass
		Block Valve Valve on 1-35-D-13/14 25-D-13/14 PSV64 3/4" block bypass
		Block Valve Valve on 1-35-D-18 Bz Col Bot Clay Treater PSV 91 1.5" block bypass
		Block Valve Valve on 1-35-D-19 Bz Col Bot Clay Treater PSV 92 1.5"block bypass
		Block on 1-35-D-8/9 Clay Treater Bottoms
		Block Valve on 1-35-D-8 Clay Treater PSV-75 3/4" Block Bypass
		Block Valve on 1-35-D-9 Clay Treater PSV-76 3/4" Block Bypass
		Block Valve Valve on 1-35-F-50 Bz Col Bot Clay Treater Eff Filter Pot PSV 93 1.5" block bypass
		Block Valve Valve on 1-35-F-51 Bz Col Bot Clay Treater Eff Filter Pot PSV94 1.5" block bypass
		Block Valve Valve on 1-35-E-48A (S) inlet Bz Col Bot Clay Treater Eff Filter Pot from E-48C PSV-111 1.5" block bypss
		Blck valve for Clay treater 35-D-8/9
		Block Valve Valve on 1-35-E-48A (T) outlet Bz Col Bot E-48C PSV-112 1.5" block bypass
		Block Valve Valve on 1-35-D-20 No. 1 Cumene Col Ovhd Line PSV 95 1.5" block bypass
		Block Valve Valve on 1-35-D-20 No. 1 Cumene Col Ovhd Line PSV 96 1.5" block bypass
		Block Valve Valve on 1-35-D-20 No. 1 Cumene Col Ovhd Line PSV 97 1.5" block bypass
		Block Valve Valve on 1-35-F-46 No. 1 Cumene Ovhd Rec PSV 98 1.5" block bypass
		Block Valve Valve on 1-35-G-78/79 1-35-G-78/79 Case Vents
		Block Valve Valve on SAM 525 Deprop OVHD Reflux
		Block Valve Valve on 1-35-D-2 No. 1 Reactor 35-PSV-6 1.5" Block Bypass
		Block Valve Valve on 1-35-D-16 No. 2 Cumene Col Ovhd Line PSV-74 1.5" Block Bypass
		Block Valve Valve on 1-35-F-34 No. 2 Cumene Col Ovhd Rec PSV-114 1.5" Block Bypass
		Block Valve on 1-35-G-85/86 Vent from No. 2 Rect charge
		Block Valve Valve on 1-35-E-41 outlet C3/C3' Charge to 1-35-E-7/8 PSV-121 1" Block Bypass'

Lube (Qs)	Sources	Detailed Source Description
$Q_{(Cume)}$ Cumene Equipment	10 Pump Seals	RO Vents on 1-35-G-4 Deprop Bottoms Pump
		RO Vents on 1-35-G-3 Reactor Charge Pump
		RO Vents on 1-35-G-8 Spare to both above
		RO Vents on 1-35-F-58/59 1-35-G-82/83
		RO Vents on 1-35-F-54/55 1-35-G-78/79
		RO Vents on 1-35-F-56/57 1-35-G-80/81
		RO Vents on 1-35-F-61/G-84 Seal Pot Vent/Deprop Bot
		RO Vents on 1-35-G-57 1-35-G-57 Seal Pot F-80
		RO Vents on 1-35-G-58 1-35-G-58 Seal Pot F-81
		Nitrogen purge on 1-35-G-27 mechanical seal to Lube Flare (M20134491-001)
	2 Control Valves	1-35-PV-6B Control Valve on 1-35-F-8 Bz Col Ovhd Rec
		1-35-PV-53C Control Valve on 1-35-D-17 No. 2 Rect Ovhd to F-33
	1 Sample Station	Block Valve on Sample Line From Sample Cooler (SAM 509)
$Q_{(\#5/LEP)}$ #5 Crude/LEP Equipment	32 PSVs	1-37-PSV-70 on 37-F-19
		1-41-PSV-123 on 1-41-E-3 (S) inlet Kerosene Product
		1-41-PSV-118 on 1-41-E-4 (S) inlet Diesel Product
		1-41-PSV-119 on 1-41-E-5B (S) inlet Upper Side P/A
		1-41-PSV-124 on 1-41-E-2 (S) outlet HSRN to 183/184 Tks
		1-41-PSV-120 on 1-41-E-6B (S) inlet Lower Side P/A
		1-41-PSV-121 on 1-41-E-7B (S) inlet HGO P/A
		1-41-PSV-49 on 1-41-E-8 (S) inlet Preflash Crude
		1-41-PSV-106 on 1-41-E-10A (S) inlet Preflash Crude from E-10B
		1-41-PSV-107 on 1-41-E-10B (S) inlet Preflash Crude from E-8
		1-41-PSV-81 on 1-41-F-1 Crude Col Ovhd Rec
		1-41-PSV-82 on 1-41-F-1 Crude Col Ovhd Rec
		1-41-PSV-76 on 1-41-F-7 Crude Col Ovhd Coalescer
		1-41-PSV-102 on 1-41-F-8 Top P/A Coalescer
		1-41-PSV-66 on 1-41-D-1 Crude Col Ovhd line
		1-41-PSV-67 on 1-41-D-1 Crude Col Ovhd line
		1-41-PSV-111 on 1-41-D-1 Crude Col Ovhd line
		1-41-PSV-113 on 1-41-D-1 Crude Col Ovhd line
		1-41-PSV-64 on 1-41-D-1 Crude Col Ovhd line
		1-41-PSV-65 on 1-41-D-1 Crude Col Ovhd line
		1-41-PSV-112 on 1-41-D-1 Crude Col Ovhd line
		1-41-PSV-114 on 1-41-D-1 Crude Col Ovhd line
		1-43-PSV-49 on 1-43-E-2 (T) inlet Dehexanizer Bottoms
		1-43-PSV-47 on 1-43-E-13A (T) inlet LSR from No. 5 Crude Ovhd
		1-43-PSV-55 on 1-43-D-1 Stripper Ovhd line
		1-43-PSV-15 on 1-43-D-3 Absorber Ovhd line
		1-43-PSV-29 on 1-43-D-2 Dehexanizer Ovhd line
		1-43-PSV-33 on 1-43-F-2 Dehex Ovhd Acc
		1-43-PSV-12 on 1-43-E-12 (S) Natural Gas Vaporizer
		1-43-PSV-36 on 1-43-F-4 Fuel Gas Drum
		1-43-PSV-57 on 1-43-F-18 LEP Comp Suc Drum (gases)
		1-43-PSV-58 on 1-43-GC-30 LEP Comp discharge to Abs

Lube (Qs)	Sources	Detailed Source Description
$Q_{(\#5/LEP)}$ #5 Crude/LEP Equipment	23 Block Valves	Block on 1-43-F-4 Fuel Gas Drum RV Bypass
		Block on Sampler Vent LEP Comp Suc Drum (gases)
		Block on 1-43-G-1/2 Dehex Ovhd pump vents
		Block Valve on 1-41-F-35 Stranded Gas KO Pot
		Block Valve on 1-43-F-18 LEP Compressor Suction Drum 4" block bypass
		Block Valve on 1-43-F-4 Lube Plant Fuel Gas Drum
		Block Valve on 1-43-F-30 Fuel Gas KO Pot
		Block Valve on 1-41-F-1 #5 Crude OVHD Reciever 4" Block Bypass around PV-7B
		Block Valve on SAM 674 Vent Absorber OffGas
		Block Valve on SAM 672 Vent Dehex OVHD
		Block Valve on 1-43-GC-30 LEP compressor PSV58 4" block bypass
		Block Valve on 1-43-GC-30 LEP compressor distance piece packing vents
		Block Valve on 1-43-E-2 (T) inlet Dehexanizer Bottoms PSV49 2" block bypass
		Block Valve on 1-43-D-1 Stripper Ovhd line PSV55 3" block bypass
		Block Valve on 1-43-D-3 Absorber Ovhd line PSV15 2" block bypass
		Block Valve on 1-43-F-2 Dehex Ovhd Acc PSV33 2" block bypass
		Block Valve on 1-41-E-3 (S) inlet Kerosene Product PSV 123 1" block bypass
		Block Valve on 1-41-E-4 (S) inlet Diesel Product PSV 118 1"block bypass
		Block Valve on 1-41-E-5B (S) inlet Upper Side P/A PSV119 1" block bypass
		Block Valve on 1-41-E-2 (S) outlet HSRN to 183/184 Tks PSV 124 1.5" block bypass
		Block Valve on 1-41-D-1 Crude Col Ovhd line PSV64 8" block bypass
		Block Valve on 1-41-E-6B (S) inlet Lower Side P/A PSV-120 1.5" block bypass
		Block Valve on 1-41-E-7B (S) inlet HGO P/A PSV-121 1.5" block bypass
	1 Sweep	1-41-F-34 Sweet Fuel Gas Purge
	1 Control Valve	1-41-PV-7B on 1-41-F-1 Crude Col Ovhd Rec Off-gas
	8 Pump Seals	RO Vents on 1-41-G-3 Preflash Bottoms 41-G-3 Inboard Seal Pot 41-F-51
		RO Vents on 1-41-G-3 Preflash Bottoms 41-G-3 Outboard Seal Pot 41-F-52
		RO Vents on 1-41-G-4 Preflash Bottoms 41-G-4 Inboard Seal Pot 41-F-53
		RO Vents on 1-41-G-4 Preflash Bottoms 41-G-4 Outboard Seal Pot 41-F-54
		Pump Seals on 1-41-G-20 Diesel / HGO Product Pump - Seal Pot
		Pump Seals on 1-41-G-21 HGO Pump Around Pump - Seal Pot
		Pump Seals on 1-41-G-22 HGO or LSR P/A Pump - Seal Pot
		Pump Seals on 1-41-G-23 HGO Product Pump - Seal Pot
	1 Sample Stations	Sample Stations on I-43-AI-5 routed to lube flare header (M20136213-001)
	1 Compressor Seal	Temporary Seal compressor on 1-37-F-20 (Tail Gas Compressor) to the flare header 1-14-F-10
$Q_{(4" C3)}$ 4" Line Propane Driers Equipment	5 Block Valves	25-D-13/14 PSV-61 Bypass 1"
		25-D-13/14 PSV-64 Bypass 3/4"
		1-35-D-13 No.1 Propane Absorber PSV-62 bypass 3/4"
		1-35-D-14 No. 2 Propane Absorber PSV-63 bypass 2"
		1-35-F-28 Propane Reg Coalescer PSV-61 bypass 1"

Lube (Qs)	Sources	Detailed Source Description
$Q_{(4" C3)}$ **4" Line Propane Driers Equipment**	5 PSVs	1-35-PSV-62 on 1-35-D-13 No. 1 Propane Absorber
		1-35-PSV-63 on 1-35-D-14 No. 2 Propane Absorber
		1-35-PSV-59 on 1-35-F-26 Propane Coalescer
		1-35-PSV-61 on 1-35-F-28 Propane Reg Coalescer
		1-35-PSV-64 on 1-35-D-13/14 Propane to D-13/14
$Q_{(TF/R)}$ **South End Tank Farm/Racks**	7 PSVs	1-16-PSV-5 on 1-16-F-2 Propane Degassing Drum
		1-16-PSV-4 on Propane Cavern Propane Cavern Dome
		PSV on Raffinate from SE to Tank 765
		2-27-PSV-202 on Butane from LPG Loading Rack
	9 Block Valves	Block on 1-14-F-15 1-14-G-64 Seal Reservoir
		Block on 1-7-G-325/472/473 Bz pump Tandum seal vents
		Block on Purchased C4 to 2-66-F-13
		Block on LPG Railcar to 2-66-F-13
		Block on LPG Railcar to 2-66-F-13
		Block on LPG Railcar to 2-66-F-13
		Block on LPG Railcar to 2-66-F-13
		Block on LPG Railcar to 2-66-F-13
		Block on Tubing from SA Fuel Gas Analyzer to flare (M20136525)
	1 Sweep	

Lube (Qs)	Sources	Detailed Source Description
$Q_{(3" C3)}$ 3" Line Propane Driers Equipment	2 Control Valves	LV-36 (1" Control Valve) Propane Coalesscer H20 Boot
		C3 Dryer Level Control LV-33
	1 Block Valve	Propane Coalesscer H20 Boot LV-36 bypass
$Q_{(PB)}$ Propylene Bullets Equipment	6 PSVs	PSV-90 on 35-E-53 Propylene Vaporizer
		PSV-115 on 35-E-61 Propylene Vaporizer
		PSV-9 on 35-T-91 Propylene Tank 91
		1-7-PSV-10 on Tank 91 C3/C3' Combined Charge
		1-7-PSV-11 on Tank 92 C3/C3' Combined Charge
		1-7-PSV-12 on Tank 92 C3/C3' Combined Charge
	4 Block Valves	Block Valve Valve on Tank 91 C3/C3' Combined Charge PSV-9 3" block bypass
		Block Valve Valve on Tank 92 C3/C3' Combined Charge PSV-11 3" block bypass
		Block Valve Valve on 1-35-T-91/92 C3/C3' Combined Charge PSV-90 1" block bypass
		Block Valve Valve on 1-35-T-91/92 C3/C3' Combined Charge PSV-115 1" block bypass
$Q_{(MS)}$ MSAT Sulfolane Equipment	10 PSVs	PSV-914 on 27-D-31 Water Wash Column
		PSV-926 C on 27-F-57 Splitter OVHD Accumulator
		PSV-929 on 27-F-57 Splitter OVHD Accumulator
		PSV-944 on 27-E-82 Heavy Reformate Exchanger
		PSV-962 on 27-E-82 Heavy Reformate Exchanger
		PSV-961 on 27-E-63 Dehexanizer Feed Exchanger
		PSV-958 on 27-E-60 Dehexanizer Feed Exchanger
		PSV-951 on 27-E-2 Reformate Splitter Feed Exchanger
		PSV-972 on 27-E-2 Reformate Splitter Feed Exchanger
		PSV-922 on 27-D-30 Reformate Splitter
		PSV-938 on 27-D-30 Reformate Splitter
	8 Block Valves	Bypass PSV-922 on 27-D-30 Reformate Splitter 12" block
		Bypass PSV-938 on 27-D-30 Reformate Splitter 12" block
		Bypass PSV-951 on 27-E-2 Reformate Splitter Feed Exchanger
		Bypass PSV-961 on 27-E-63 Dehexanizer Feed Exchanger
		Bypass PSV-958 on 27-E-60 Dehexanizer Feed Exchanger
		Bypass PSV-914 on 27-D-31 Water Wash Column
		Bypass PSV-962 on 27-E-82 Heavy Reformate Exchanger
		Bypass PSV-972 on 27-E-2 Reformate Splitter Feed Exchanger
$Q_{(1LGC)}$ Lower Gas Con #1 Line	1 PSV	2-27-PSV-110 on 2-27-F-43 BIU Hydrogen KO Drum
$Q_{(2LGC)}$ Lower Gas Con #2 Line	NA	No active equipment on line

Lube (Qs)	Sources	Detailed Source Description
$Q_{(3LGC)}$ Lower Gas Con #3 Line Equipment	8 PSVs	2-24-PSV-107 on2-24-F-60 Carbon Treater Sand Filter
		2-24-PSV-108 on2-24-F-61 Carbon Treater Sand Filter
		2-3-PSV-106 on2-3-F-10 Propane Carbon Treater
		2-3-PSV-126 on2-3-F-31 Blowdown Drum Accumulator
		2-3-PSV-105 on2-3-D-1 Propane Carbon Treater
		2-66-PSV-15 on 2-66-F-13 SA Gas Drum
		2-24-PSV-68 on2-24-F-39 GC C3/C4 Water Settler
		2-24-PSV-84 on2-24-D-5 SG Deprop Fd Caustic Scrub
	3 Block Valves	Block Valve on 24-F-60 Carbon Treater Sand Filter PSV107 1" bypass line
		Block Valve on 24-F-61 Carbon Treater Sand Filter PSV108 1" bypass line
		Block Valve on Flare Drop on top of #9 Bldg
$Q_{(4LGC)}$ Lower Gas Con #4 Line Equipment	2 Pump Seals	Pump Seal Pot Vents 2-2-G-202
		Pump Seal Pot Vents 2-2-G-203
	8 PCVs	2-3-PSV-131 on 2-3-F-45 Alky Butane Feed Coalescer
		2-3-PSV-132 on 2-3-F-46 Alky Butane Feed Coalescer
		2-3-PSV-120 on 2-3-F-51 Alky Butane Feed Water Sep
		2-24-PSV-3 on 2-24-D-3 Naphtha Desulfide Scrubber
		2-24-PSV-40 on 2-24-D-26 HCC Caustic Scrubber
		2-2-PSV-001 on 2-2-D-1 Aux Splitter Ovhd line
		2-2-PSV-12 on 2-2-F-1 Aux Splitter Ovhd Acc
	1 Block Valve	Block Valve on 2-3-F-51 Alky Butane Feed Water Sep 2-3-PSV-120 4" block bypass
$Q_{(5LGC)}$ Lower Gas Con #5 Line Equipment	12 PSVs	2-2-PSV-32 on 2-2-E-3 (T) inlet Aux Splitter Btms to Alky
		2-2-PSV-214 on 2-2-E-2 (S) outlet Aux Splitter Btms Reboiler
		2-5-PSV-19 on #2 Tank Car Rack PSV
		2-30-PSV-56 on 2-30-E-39 Propane Chiller
		2-66-PSV-1 on 2-66-F-1 SA Fuel Gas Drum
		2-24-PSV-89 on MEA scrubber 2-24-D-38
		2-5-PSV-12 Butane Vaporizoer 2-5-E-8
		2-30-PSV-93 on 2-30-F-10 Deprop Feed Surge Drum
		2-24-PSV-22E on2-24-F-9 SG Deprop Fd Caustic Scrub
		2-24-PSV-86 on 2-24-F-56 GC C3/C4 Mercaptan Extract
		2-24-PSV-24 on 2-2-D-12 Caustic Oxidizer
		2-24-PSV-125 on 2-24-F-17 Spent Caustic Holding Drum
		2-24-PSV-126 on 2-24-F-18 Spent Caustic Holding Drum
		2-24-PSV-14 on 2-24-F-17 Spent Caustic Holding Drum
		2-24-PSV-15 on 2-24-F-18 Spent Caustic Holding Drum
		2-24-PSV-16 on 2-24-F-19 Spent Caustic Holding Drum
		2-24-PSV-99 on 2-24-D-2S SG Deprop Feed Mer Extract
	7 Block Valves	Block Valve on KOG Natural Gas Tank Car
		Block Valve on -- #2 Tank Car Rack Vent
		Block Valve on Near 2-2-E-2 Flare Drop
		Block on Sampling System vent GC C3/C4 Mercaptan Extract
		Block on 2-24-F-17/18/19 Spent Caustic Holding Drum
		Block Valve on 2-2-D-12 LGC Caustic Oxidizer vent
		Block Valve on 2-4-D-2 T/B C3/C4 Caustic Prewash Drums 2-4-PSV-115 3" block bypass

Lube (Qs)	Sources	Detailed Source Description
$Q_{(6LGC)}$ Lower Gas Con #6 Line Equipment	12 PSVs	2-66-PSV-3 on 2-66-F-4 SA Sour Fuel Gas KO Pot
		2-30-PSV-2 on 2-30-F-6 Naph Fract Ovhd line to Drum
		2-30-PSV-7 on 2-30-F-6 Naph Fract Reflux Drum
		2-30-PSV-29 on 2-30-F-13 No. 2/3 CU Naph Coalescer
		2-30-PSV-72 on 2-30-E-13 (T) outlet Hot Oil
		2-30-PSV-93 on 2-30-F-10 Deprop Feed Surge Drum
		2-30-PSV-69 on 2-30-F-11 Deprop Reflux Drum
		2-30-PSV-9 on 2-30-E-14A (T) outlet Debutanizer Feed
		2-30-PSV-74 on 2-30-E-31 inlet Naphtha from 2-30-E-6A/B
		2-24-PSV-92 on 2-24-D-40 SG Deprop Fd MDEA Scrub
		2-24-PSV-93 on 2-24-F-57 SG Deprop Fd Water Wash
		2-24-PSV-94 on 2-24-F-58 SG Deprop Fd Coalescer
	24 Block Valves	Block Valve on 2-66-F-5 Sweet FG KO Pot 2-66-PSV-3 4" block bypass
		Block Valve on 2-66-F-1 SA Fuel Gas Drum 2-66-PSV-1 2" block bypass
		Block on Absorber Ovhd Sampling System vent
		Block on Main Splitter Ovhd Sampling System vent
		Block on Aux Splitter Ovhd Sampling System vent
		Block on Stripper Bottoms Sampling System vent
		Block on Main Debut Ovhd Sampling System vent
		Block on Sec Debut Ovhd Sampling System vent
		Block on 2-30-G-2/21/21A Abs Bottoms pump vents
		Block on 2-30-G-3/3A Naphtha Lean Oil pump vents
		Block on 2-30-G-5 Naph Fract Reflux pump vents
		Block on 2-30-G-6A Common Spare pump vents
		Block on 2-30-G-6 Debutanizer Feed pump vents
		Block on 2-30-G-8/8A Debut Reflux pump vents
		Block on 2-30-G-26/27 Deprop Feed pump vents
		Block on 2-30-F-10 Deprop Feed Surge Drum
		Block on 2-30-G-10 Deprop Reflux Pump vent
		Block on 2-30-F-11 Deprop Reflux Drum
		Block on 2-30-G-11 Naph De Reb pump vent
		Block on 2-30-G-11A Common Spare pump vent
		Block on 2-30-G-12 Naph De Exch Side pump vent
		Block on 2-30-F-15 Sat Gas Flare KO Drum
		Block Valve on 2-30-F-24 Fuel Gas KO Pot
		Block valve on 2-30-G-22 30-G-22 Pump drain
	6 Sampling Stations	Absorber Ovhd Sampling System vent
		Main Splitter Ovhd Sampling System vent
		Aux Splitter Ovhd Sampling System vent
		Stripper Bottoms Sampling System vent
		Main Debut Ovhd Sampling System vent
		Sec Debut Ovhd Sampling System vent
	4 Pump Seals	2-30-G-6A Reservoir vent RO-321
		2-30-G-10 Reservoir vent RO-320
		2-30-G-11 Reservoir vent RO-322
		2-30-G-11A Reservoir vent RO-323

Lube (Qs)	Sources	Detailed Source Description
Q(SP) Sulfolane Products	16 PSVs	1-27-PSV-38 on 1-27-D-13 #1 Toluene Column
		1-27-PSV-36 on 1-27-D-11 Xylene Col Ovhd line
		1-27-PSV-51 on 1-27-D-17 Benzene Column
		1-27-PSV-53 on 1-27-D-4 Stripper Col Ovhd to Cond's
		1-27-PSV-105 on 1-27-F-31 Recovery Column OVHD Accumulator
		1-27-PSV-43 on 1-27-D-14 Recovery Col Ovhd line
		1-27-PSV-968 on 1-27-D-17 Bz Col Ovhd line
		1-27-PSV-965 on 1-27-D-13 No. 1 Tol Col Ovhd line
		1-27-PSV-76 on 1-29-D-13 Reformate Dehexanizer
		1-27-PSV-79 on 1-27-F-44 Reform Dehex Ovhd Acc
		1-27-PSV-87 on 1027-D-13 inlet Reformate Dehex feed
		1-29-PSV-87 on 1-29-E-75 (T) outlet Raff Dehex Bot to 1-29-E-82
		1-29-PSV-107 on 1-29-E-75 (S) outlet Raff Dehex Col Charge
		1-29-PSV-74 on 1-29-D-16 Raff Dehex Ovhd line
		1-7-PSV-815 on Raffinate to Storage Relief
		1-27-PSV-100 on 1-27-E-31B (S) inlet Bz Side Cut Rec to storage
	10 Block Valves	Block on 1-27-G-9B Pump vent line
		Block on 1-27-G-21A Pump vent line
		Block on 1-27-E-54/F-50 vents Recovery Col Ejector System Non-condens
		Block on 1-27-D-17 Bz Col Ovhd line
		Block on 1-27-D-13 No. 1 Tol Col Ovhd line
		Block on 1-27-G-21B Pump vent line
		Block on 1-27-G-41A Pump vent line
		Block Valve on Sulfolane Recovery Column Ejector
		Block Valve on 1-27-E-31B (S) inlet Bz Side Cut Rec to storage PSV 100 1" block bypass
		Block on 1-27-G-41B Pump vent line
	2 Pump Seals	Pump Seals on 1-27-G-28 Recovery Column Reflux Pump - Seal Pot
		Pump Seals on 1-27-G-29 Recovery Column Reflux Pump - Seal Pot
	1 Seal Pot	Seal Pot on 1-27-F-49 Xylene Column OVHD - Seal Pot
	1 Control Valve	1-27-PV-111C on 1-27-F-44 Reform Dehex Ovhd Acc
	1 Vent	No. 1, 2 Tol & Xylene Rec Vents 1-27-F-49
	1 Sample Station	1-27-SAM-321 LP Dehex Ohd Sample
Q(SF) Sulfolane Feed	7 PSVs	1-27-PSV-92 on 1-27-D-15 Water Stripper Ovhd line
		1-27-PSV-83 on 1-27-D-1 Sulf Reformate Splitter Ovhd
		1-27-PSV-84 on 1-27-D-1 Sulf Reformate Splitter Ovhd
		1-27-PSV-93 on 1-27-D-20 New Extractor
		1-27-PSV-62 on 1-28-E-7 (T) inlet Clay Treater Charge
		1-27-PSV-50 967 on 1-27-E-42A (S) Clay Treater Charge
		1-29-PSV-01 on 1-29-B-6 outlet Hot Oil

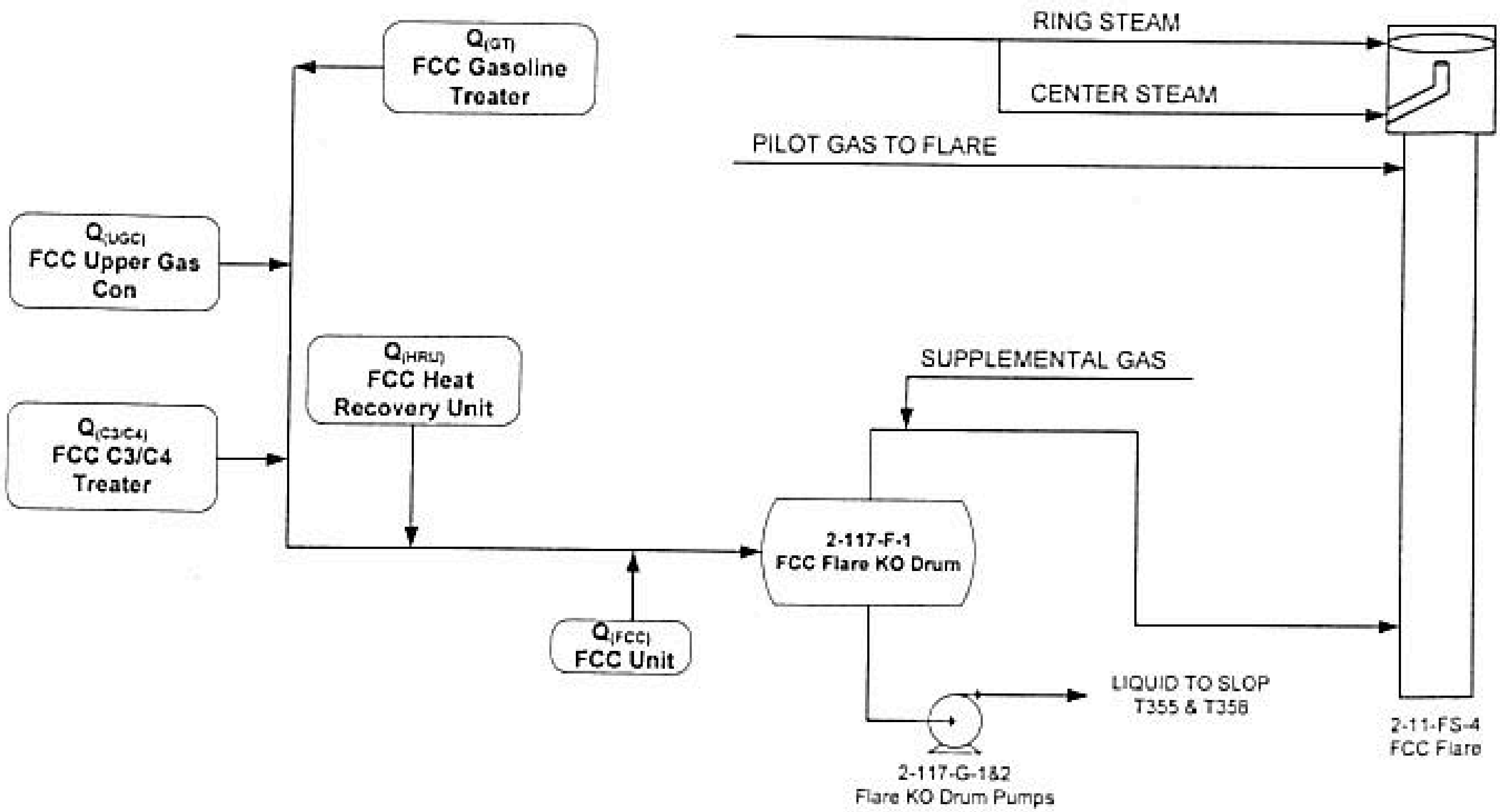
Lube (Qs)	Sources	Detailed Source Description
$Q_{(SF)}$ Sulfolane Feed	17 Block Valves	Valves Block on 1-27-F-29 Vent Pot
		Valves Block on 1-27-SAM-901 HP Dehex Ohd Sample
		Valves Block on 1-27-G-50 Pump vent line
		Valves Block on 1-27-G-51 Pump vent line
		Valves Block on 1-27-G-46A Pump vent line
		Valves Block on 1-27-G-46B Pump vent line
		Valves Block on 1-27-G-90 Pump vent line
		Valves Block on 1-27-G-16A Pump vent line
		Valves Block on 1-27-G-16B Pump vent line
		Valves Block on 1-27-G-38A Pump vent line
		Valves Block on 1-27-G-38B Pump vent line
		Valves Block on 1-27-G-44 Pump vent line
		Valves Block on 1-27-G-45A Pump vent line
		Valves Block on 1-27-G-45B Pump vent line
		Valve Block Valve on 1-27-D-20 New Extractor 27-PSV-93 1.5" Block Bypass
		Valve Block Valve on 1-27-D-15 Water Stripper Ovhd line 27-PSV-92 1" Block Bypass
		Valve Block Valve on 1-27-F-55 outlet Lean Solvent PSV89 1.5" block bypass
	3 Control Valves	Control Valve 1-27-PV-111C on 1-27-F-44 Reform Dehex Ovhd Acc
		Control Valve 1-27-PV-2B on 1-27-D-20 New Extractor
		Control Valve 1-27-PV-940C on 1-27-F-1 Splitter Ovhd Rec
	2 Sample Stations	
	3 Pump Seals	
	2 Seal Pots	
Miscellaneous Equipment	6 PSVs	1-17-PSV-97 Natural Gas -Barge Dock
		2-24-PSV-42 on 2-24-D-28 HCC Caustic Scrubber
		2-27-PSV-110 on 2-27-F-43 BIU Hydrogen KO Drum
		1-31-PSV-50 on 1-31-GC-1 SPU Compressor
		1-29-psv-64 on 1-29-B-2/4-B-6 outlet Hot oil
		PSV-115 on 66-F-16 Pchem Fuel Gas Crum
	3 Block Valves	Valves Block on 1-4-F-7 Preflash Ovhd to Pref Ovhd
		valve from 5-F-21
		valve from 5-F-22
	1 Sample Station	Propane (C3) dryer sample station
		Sampling System vent GC C3/C4 Mercaptan Extract

Header Flow	Flow Estimate (scfd)	Basis For Estimate
Q(PCE) Propane Cavern Equipment	1,272,336	Tracerco
Q(PCE) Butane Cavern	20,400	Max known daily flow from cavern vent
$Q_{(P\_FG)}$ Pchem FG Equipment	13,438	Tracerco distributed using Compnent counts
$Q_{(TF/R)}$ South End Tank Farm/Racks	15,673	Tracerco distributed using Compnent counts
$Q_{(HO)}$ Hot Oil	3,804	Tracerco distributed using Compnent counts
$Q_{(ADSC)}$ ADS Charge	15,329	Tracerco distributed using Compnent counts
Q (CT) Clay Treaters	13,280	Tracerco distributed using Compnent counts
$Q_{(SF)}$ Sulfolane Feed	21,654	Tracerco distributed using Compnent counts
$Q_{(CTLO)}$ CTLO	6,703	Tracerco distributed using Compnent counts
Q (GC) Guard Case	20,015	Tracerco distributed using Compnent counts
$Q_{(ADS2)}$ ADS Misc.	48,184	Tracerco distributed using Compnent counts
(Q_{SPUC}) SPU Compressor	110,388	Tracerco distributed using Compnent counts
$Q_{(GO)}$ Old G-Oil Header	47,278	Tracerco distributed using Compnent counts
$Q_{(Dehex)}$ Sulfolane Dehezanizer	94,556	Tracerco distributed using Compnent counts
$Q_{(F55)}$ Fuel Gas KO Pot	32,425	Tracerco distributed using Compnent counts

Header Flow	Flow Estimate (scfd)	Basis For Estimate
$Q_{(\#5/LEP)}$ #5 Crude/LEP Equipment	132,936	Tracerco
$Q_{(S)}$ Scrub Unit	0	Scrub OOS
$Q_{(Cume)}$ Cumene Equipment	452,376	Tracerco
$Q_{(5LGC)}$ Lower Gas Con #5 Line Equipment	31,191	Tracerco distributed using Component counts
$Q_{(3LGC)}$ Lower Gas Con #3 Line Equipment	18,505	Tracerco distributed using Component counts
$Q_{(4LGC)}$ Lower Gas Con #4 Line Equipment	23,036	Tracerco distributed using Component counts
$Q_{(1LGC)}$ Lower Gas Con #1 Line Equipment	3,020	Tracerco distributed using Component counts
$Q_{(6LGC)}$ Lower Gas Con #6 Line Equipment	42,195	Tracerco distributed using Component counts
$Q_{(SP)}$ Sulfolane Products	90,000	Estimate based of flow indicator
$Q_{(ADS)}$ ADS	7,200	Based on pump seals and compressor seals
$Q_{(LPCCR)}$ LPCCR Equipment	560,000	Based on max and min on FI
$Q_{(MS)}$ MSAT Sulfolane Equipment	2,000	AP-42 leak rate calculation

Appendix E

FCC Flare Waste Gas Flows


RING STEAM
CENTER STEAM
PILOT GAS TO FLARE
Q(GT)
FCC Gasoline Treater
Q(UGC)
FCC Upper Gas Con
Q(HRU)
FCC Heat Recovery Unit
Q(C3/C4)
FCC C3/C4 Treater
SUPPLEMENTAL GAS
2-117-F-1
FCC Flare KO Drum
Q(FCC)
FCC Unit
LIQUID TO SLOP
T355 & T358
2-117-G-1&2
Flare KO Drum Pumps
2-11-FS-4
FCC Flare

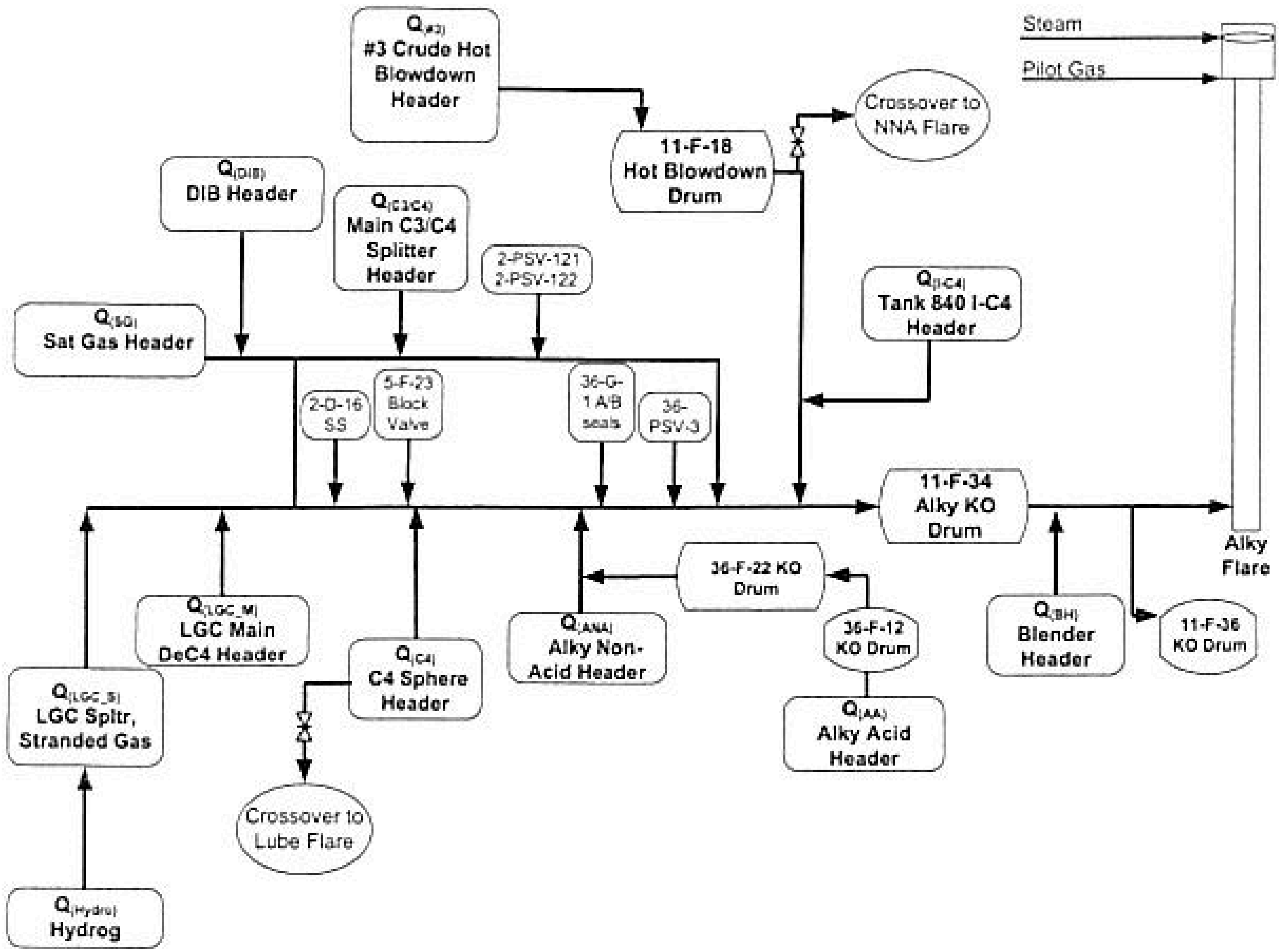
FCC Flare Header Flows (Qs)	Sources	Detailed Source Description
$Q_{(UGC)}$ FCC Upper Gas Con	11 PSVs	2-110-PSV-22 on 2-110-F-3 High Pressure Reciver 2-110-PSV-2 on 2-110-F-4 Stripper Charge Coalescer 2-110-PSV-16 on 2-110-D-3 Stripper 2-110-PSV-24 on 2-110-E-8(T) LCO from 2-110-G-13/14 2-110-PSV-18 on 2-110-E-15 Debutanizer Reboiler 2-110-PSV-19 on 2-110-E-14 Debutanizer Reboiler 2-110-PSV-4 on 2-110-D-4 Bebut Ovhd line to Receiver 2-110-PSV-21 on 2-110-D-4 Debut Ovhd line to Receiver 2-110-PSV-5 on 2-110-F-5 Debutanizer Ovhd Receiver 2-110-PSV-6 on 2-110-D-5 Fuel Gas Amine Absorber 2-110-PSV-27 on 2-110-F-101 WG Compressor Suc Drum 2-110-PSV-017 on 2-110-E-12
	2 Sample Stations	
	1 Compressor Seal	2-110-GC-1 Seal Vent
	6 Block Valves	2-110-E-13A/C inlet Debut Ovhd line to Reciver 2-110-F-7 sampelr FG Amine KO Drum Ovhd 2-110-F-7 FG Amine KO Drum Ovhd 2-110-F-101 WG Comp Suc Drum Liquid 2-110-GC-1 WG Comp Discharge drain 2-110-GC-1 WG Compressor drain
$Q_{(C3/C4)}$ FCC C3/C4 Treater	3 PSVs	2-113-PSV-1 on 2-113-D-1 Amine Scruber (removed alumina treater 2-113-D-2) 2-113-PSV-3 on 2-113-F-1 Mercaptan Extractor 2-113-PSV-4 on 2-113-F-3 Water Wash
	1 Block Valves	2-113-E-3 (S) inlet C3/C4 from MDEA Scrubber (removed alumina treater 2-113-D-2)
$Q_{(GT)}$ FCC Gasoline Treater	3 PSVs	2-114-PSV-2 on 2-114-D-1 Spent Caustic Oxidizer 2-114-PSV-3 on 2-114-D-2 Disulfide Scrubber 2-114-PSV-4 on 2-114-F-4 Naptha Water Wash Drum
$Q_{(HRU)}$ FCC Heat Recovery Unit	3 PSVs	2-116-PSV-209 on 2-116-F-34 HRU Fuel Gas Drum 2-116-PSV-100 on 2-116-F-65 Oxidizer Vent KO Pot 2-66-PSV-9 Purchased Net Gas KOG Company
	1 Sample Station	2-66-AI-3 vented to lube flare(M20136525-001)
	2 Block Valves	2-116-F-34 Fuel Gas Drum Bot drain 2-66-F-8 Fuel Gas KO Pot

FCC Flare Header Flows (Qs)	Sources	Detailed Source Description
$Q_{(FCC)}$ FCC Unit	19 PSVs	2-109-PSV-23 on 2-109-E-8 (T) inlet LCO Products 2-109-PSV-24 on 2-109-D-3 Main Column OVHD line 2-109-PSV-25 on 2-109-D-3 Main Column OVHD line 2-109-PSV-26 on 2-109-D-3 Main Column OVHD line 2-109-PSV-27 on 2-109-D-3 Main Column OVHD line 2-109-PSV-28 on 2-109-D-3 Main Column OVHD line 2-109-PSV-29 on 2-109-D-3 Main Column OVHD line 2-109-PSV-30 on 2-109-D-3 Main Column OVHD line 2-109-PSV-31 on 2-109-D-3 Main Column OVHD line 2-109-PSV-32 on 2-109-D-3 Main Column OVHD line 2-109-PSV-33 on 2-109-D-3 Main Column OVHD line 2-109-PSV-34 on 2-109-F-3 Low Pressure Receiver 2-109-PSV-21 on 2-109-F-3 Low Pressure Receiver 2-109-PSV-43 on 2-109-F-16 Flush Oil Surge Drum 2-109-PSV-384 on 2-109-E-42 PSV-98 on 109-G-87 seal pot of slurry pump PSV-108 on 109-G-87 seal pot of slurry pump PSV-106 on 109-G-86 seal pot of slurry pump PSV-96 on 109-G-86 seal pot of slurry pump
	1 Control Valve	2-109-PV-21 Main Column OVHD PCV-21
	4 Pump Seals	2-109-G-86, Slurry, Seal Pot 2-109-F-76 2-109-G-86, Slurry, Seal Pot 2-109-F-77 2-109-G-87, Slurry, Seal Pot 2-109-F-78 2-109-G-87, Slurry, Seal Pot 2-109-F-79
	1 Fuel Gas Sweep	SWEEP Fuel Gas Header line
	6 Block Valves	2-109-F-1 Raw Oil Charge Drum Flare Drop Flare Drop 2-109-F-16 Manual Vent Line 3" Manual Vent (include 150# steam) FCC Main Column Ohd Manual Vent of Sponge Absorber

Header Flow	Flow Estimate (scfd)	Basis For Estimate
Q(UGC) FCC Upper Gas Con	52,000	Tracerco
Q(C3/C4) FCC C3/C4 Treater	89,000	Tracerco using component counts to distribute flow
Q(GT) FCC Gasoline Treater	66,000	Tracerco using component counts to distribute flow
Q(HRU) FCC Heat Recovery Unit	69,000	Tracerco using component counts to distribute flow
Q(FCC) FCC Unit	283,000	Tracerco

Appendix F

Alky Flare Waste Gas Flows


Q(#3)
#3 Crude Hot Blowdown Header
Steam
Pilot Gas
Crossover to NNA Flare
11-F-18
Hot Blowdown Drum
Q(DIB)
DIB Header
Q(C3C4)
Main C3/C4 Splitter Header
2-PSV-121
2-PSV-122
Q(I-C4)
Tank 840 I-C4 Header
Q(SG)
Sat Gas Header
2-D-16 SS
5-F-23 Block Valve
36-G-1 A/B seals
36-PSV-3
11-F-34
Alky KO Drum
Alky Flare
36-F-22 KO Drum
Q(LGC_M)
LGC Main DeC4 Header
Q(ANA)
Alky Non-Acid Header
36-F-12 KO Drum
Q(BH)
Blender Header
11-F-36 KO Drum
Q(C4)
C4 Sphere Header
Q(AA)
Alky Acid Header
Q(LGC_S)
LGC Spltr, Stranded Gas
Crossover to Lube Flare
Q(Hydro)
Hydrog

Alky (Qs)	Sources	Detailed Source Description
$Q_{(AA)}$ Alky Acid Header	8 PSVs	2-36-PSV-7 on 2-36-F-4 Acid Storage Drum
		2-36-PSV-63 on 2-36-F-9 Isostripper Ovhd Rec
		2-36-PSV-41 on 2-36-F-10 Depropanizer Feed Settler
		2-36-PSV-50 on 2-36-D-12 New HF Acid Regenerator
		2-36-PSV-46 on 2-36-E-25/26 (S) outlet Isobutane Vaporizer
		2-36-PSV-51 on 2-36-E-26 (S) inlet Isobutane Vaporizer
		2-36-PSV-21 on 2-36-D-5 HF Stripper middle
		2-36-PSV-45 on 2-36-F-7 Polymer Surge Drum
	38 Block Valves	Block on 2-36-F-4 Acid Storage Drum
		Block on 2-36-F-5 1st Stage Acid Settler
		Block on 2-36-FV-12 Downstream
		Block on 2-36-F-9 Isostripper Ovhd Rec
		Block on 2-36-E-8B (S) outlet Isobutane sidecut
		Block on 2-36-E-8D (S) outlet Isobutane sidecut
		Block on 2-36-E-6A (S) outlet Isobutane sidecut
		Block on 2-36-F-10 Depropanizer Feed Settler
		Block on Acid from Settlers to HF Acid Regenerator
		Block on 2-36-F-11 Depropanizer Ovhd Rec
		Block on 2-36-E-14 (S) outlet Depropanizer Ovhd Cond
		Block on 2-36-F-7 Polymer Surge Drum
		Block on 2-36-G-2 Fresh Acid Pump drain
		Block on 2-36-G-3 North Acid Circ Pump drain
		Block on 2-36-G-4A South Acid Circ Pump drain
		Block on 2-36-G-4B Spare Acid Circ Pump drain
		Block on 2-36-G-7B Isobutane Reb Pump drain
		Block on 2-36-G-9A Settled Acid Pump drain
		Block on 2-36-G-9B Settled Acid Pump drain
		Block on Acid Sampling System
		Block on 2-36-F-6 2nd Stage Acid Settler
		Block on 2-36-G-10A Deprop Feed Pump drain
		Block on 2-36-G-10B Deprop Feed Pump drain
		Block on 2-36-G-11A Deprop Ovhd Pump drain
		Block on 2-36-G-11B Deprop Feed Pump drain
		Block on 2-36-E-12 (T) outlet Depropanizer Feed
		Block on Sampling Station Isobutane
		Block on 2-36-G-8A Isobutane Recycle Pump drain
		Block on 2-36-G-8B Isobutane Recycle Pump drain
		Block Valve on 36-F-22 KO Drum
		Block Valve on 36-D-7 Acid Flare Header Scrubber [Circulating KOH]
		Block Valve on 36-D-12 3/4" Vent line from acid line to 36-D-12
		Block Valve on 36-E-11A/B 3/4" Vent line from 36-E-11A/B
		Block Valve on 1 1/2" vent line on 36-G-7B
		Block Valve on 1 1/2" Vent line from 36-G-3
		Block Valve on Seal Pot on 36-G-9A
		Block Valve on Seal Pot on 36-G-9B
		Block Valve on 36-F-12 KO Pot

Alky (Qs)	Sources	Detailed Source Description
$Q_{(AA)}$ Alky Acid Header	4 Control Valves	2-36-PV-311 on 2-36-F-4 Acid Storage Drum
		2-36-PV-19B on 2-36-F-11 Depropanizer Ovhd Rec
		2-36-PV-31B on 2-36-F-57 Thermal Fluid Surge Drum
		2-36-PV-31A on 2-36-B-2 Hot Oil Heater
	3 Nitrogen Sweep	Nitrogen 3/4" line from N2 Sweep Purge
		nitrogen 3/4" line N2 Purge Purge
		nitrogen 3/4" line N2 Purge Purge
	7 Seal Pumps	Fresh Acid Pump 2-36-G-2 Seal Pump
		Deprop Feed Pump Seal Pot 2-36-G-10A
		Deprop Feed Pump Seal Pot 2-36-G-10B
		Deprop Ovhd Pump Seal Pot 2-36-G-11A
		Deprop Feed Pump Seal Pot 2-36-G-11B
		Isobutane Recycle Pump 2-36-G-8A Seal Pump
		Isobutane Recycle Pump 2-36-G-8B Seal Pump
$Q_{(ANA)}$ Alky Non-Acid Header	19 PSVs	2-36-PSV-1 on Feed Coalescer-A 2-36-F-2
		2-36-PSV-2 on Feed Coalescer-B 2-36-F-3
		2-36-PSV-6 on Nitrogen to Acid Storage Drum 2-36-F-4
		2-36-PSV-83 on Hot Oil System Exchanger Circuit 2-36-E-25
		2-36-PSV-18 on Depropanizer middle 2-36-D-4
		2-36-PSV-84 on Hot Oil System 2-36-E-17 (T) outlet
		2-36-PSV-20A on Propane Alumina Treaters 2-36-D-10A
		2-36-PSV-20B on Propane Alumina Treaters 2-36-D-10B
		2-36-PSV-40 on C3 Alumi Treaters Preheater 2-36-E-17 (S) outlet
		2-36-PSV-19 on Propane KOH Treater 2-36-D-11
		2-36-PSV-85 on Propane Flush Cooler 2-36-E-15 (S) inlet
		2-36-PSV-10 on N-Butane KOH Treater 2-36-D-9
		2-36-PSV-13 on Isostripper bottom 2-36-D-3
		2-36-PSV-48 on 2-36-F-29 ASO Surge Drum
		2-36-PSV-81 on Isostripper bottom 2-36-D-3
		2-36-PSV-4A on Butanes Feed Dryers 2-36-D-8A
		2-36-PSV-4B on Butanes Feed Dryers 2-36-D-8B
		2-36-PSV-5B on Regenerate Super Heater 2-36-E-23A (S) outlet
		2-36-PSV-5A on Regenerate Super Heater 2-36-E-23B (S) outlet
	9 Block Valves	Block on Feed Dryers 2-36-D-8A/B
		Block on Flare cond. Liq pumps 2-11-G-94/95
		Block on Flare cond liq Drum drain 2-11-F-36
		Block Valve on 2" line from Flare drop in Alky
		Block Valve on 3/4" Vent line from 36-E-1
		Double block valve on PSV bypass on PSV-20A
		Double block valve on PSV bypass on PSV-20B
		Block Valve on 3/4" Vent line from 36-E-5A/B
		Block Valve on 3/4" line from Flare Drop
	1 Nitrogen sweep	3/4" Nitrogen Sweep

Alky (Qs)	Sources	Detailed Source Description
$Q_{(C4)}$ **C4 Sphere Header**	19 PSVs	2-7-PSV - 116A on 1" line from SDA C4
		2-7-PSV - 106 on 6" line 750 TK
		2-7-PSV - 111 on 1" line from SDA C4 Transfer
		2-7-PSV - 114 on 1" line from SDA C4 Transfer
		2-7-PSV - 116 on 1" line from SDA C4 Line
		2-7-PSV - 115 on 1" lines from C4 suction line
		2-7-PSV - 117 on 1" line from 598tk suction
		2-7-PSV - 110 on 6" line from 898tk RV
		2-7-PSV - 115A on 1" line from 749tk suction
		2-7-PSV - 105 on 6" line form 749tk
		2-7-PSV - 109 on 8" line from 747tk line
		2-7-PSV - 103 on 8" line from 748tk
		2-7-PSV - 107 on 10" line from 836tk
		2-36-PSV-99 on 2-36-B-2 outlet Thermal Fluid to exchangers
		2-36-PSV-100 on 2-36-F-57 Thermal Fluid Surge Drum
		2-36-PSV-43 on Fuel Gas KO Pot 2-36-F-24
		2-36-PSV-88 on ASO Caustic Wash 2-36-F-54
		PSV-20 on Butane Pre-filter 2-606-F-5 (MOC2012661-012)
		PSV-21 on Butane Coalescer 2-606-F-6 (MOC2012661-012)
	9 Block Valves	Block Valve on 3/4" line from manual vent from C4 pumps
		Block Valve on 836 tank 1/2" tubing around PSV
		block Valve on 747 Tank bypass around PSV
		block Valve on 748 Tank bypass around PSV
		Block Valve on 24" line Jumper to SA Flare Header
		block Valve on 37-G-119 bleeders and vents (3)- 3/4"
		block Valve on 37-G-120 bleeders and vents (3)- 3/4"
		block Valve on Butane Prefilter 2-606-F-5 around PSV (MOC2012661-012)
		block Valve on Butane Coalescer 2-606-F-6 around PSV (MOC2012661-012)
	3 Pump Seal	N2 purge between tandem seals 37-G-119/120
		Pump Seals 2-5-G-4 and 2-5-G-5 on Butane storage tank 836 (MOC2012661-012)
	1 Sample Station	½' sample station line off of Butane storage tank 2-606-T-748. (MOCM2013697-001)
$Q_{(LGC\_M)}$ **LGC Main DeC4 Header**	6 PSVs	2-24-PSV-63 on Retention Tank 2-24-D-35
		2-2-PSV-160 on Main Debut Steam Reboiler 2-2-E-124 S (outlet)
		2-2-PSV-135 on Main Debut Overhead 2-2-D-14
		2-2-PSV-97 on Main Debut Overhead 2-2-D-14
		2-2-PSV-140 on Main Debut Ovhd Accum. 2-2-F-44
		2-2-PSV-100 on Main Debut Ovhd Water Boot 2-2-F-45
	1 Pump Seal	Pump Seals 1/2" line from SS Tube Seal Pot vents on 2-G-73/74 Main DeC4 Reflux pumps
	1 Block Valve	Block Valve 2" line from manual vent on 2-F-44 Main Debutanizer on overhead receiver
	1 Sample Station	Sample Station SAM 450 from C3/C4 Splitter

$Q_{(Hydro)}$ **Hydrog Header**	9 PSVs	2-115-PSV-1 on Charge Drum 2-115-F-1
		2-115-PSV-2 on Charge Drum Water Pot 2-115-F-4
		2-115-PSV-4 on Feed Coalescer 2-115-F-3
		2-115-PSV-7 on H2 Compressor Suction Drum 2-115-F-2
		2-115-PSV-10 on H2 Compressor Discharge 2-115-GC-3
		2-115-PSV-8 on Reactor Feed 2-115-E-3 (T) inlet
		2-115-PSV-9 on Reactor Feed 2-115-E-4 (T) inlet
		2-115-PSV-5 on Reactor outlet 2-115-D-2
		2-115-PSV-6 on Product Stripper 2-115-D-1

Alky (Qs)	Sources	Detailed Source Description
$Q_{(LGC\_S)}$ **LGC Spltr, Stranded Gas**	10 PSVs	2-2-PSV-200 on C3/C4 Splitter Charge Drum 2-2-F-75
		2-2-PSV-212 on Charge Drum Vaporizer 2-2-E-127 T (outlet)
		2-2-PSV-133 on Splitter Charge Coalescer 2-2-F-76
		2-2-PSV-148 on Main Splitter Feed 2-2-E-98 S (outlet)
		2-24-PSV -58 on 4" line from new Sour Naptha Wash 24-F-80
		2-30-PSV - 352 6" line from Comp Discharge 2-30-F-45
		2-30-PSV - 351 10" Comp. Suction 2-30-F-40
		2-30-PSV - 354 4" line from KO Drum 2-30-F-41
		2-24-PSV-88 on 6" line from HCC Precip 24-F-49
		PSV -15 on 1" line from LSR Tranfer line
	7 Block Valves	Block on C3/C4 Splitter Charge Drum 2-2-F-75
		Block on Splitter Charge Pumps (disch) 2-2-G-204/205
		Block Valve on 3" line from F-47 Break Tank
		Block Valve on 3/4" line from Flare Drop
		Block Valve on 2" line from Flare Drop
		Block Valves on 2" line from Stranded Gas Compressor Vents 2-30-GC-10
		Block Valve on 2" Vent on C3/C4 Splitter Charge Drum 2-2-F-75
	1 Pump Seal	Split Chg Pumps Seal Pots 2-2-G-204/205
	1 Sample Station	Sample Station 1" line from LGC Cem Building
	1 Comp. Seal	2" line from Comp Vents Compressor Seal
$Q_{(SG)}$ **Sat Gas Header**	19 PSVs	2-30-PSV-3 on Sat Gas Absorber2-30-D-1
		2-30-PSV-43 on Sat Gas Absorber Ovhd line2-30-D-1
		2-30-PSV-65 on Naph Deethanizer Side P/A2-30-E-9A (S) inlet
		2-30-PSV-66 on Naph Deethanizer Side P/A2-30-E-9B (S) outlet
		2-30-PSV-71 on Stab Deethan Charge Drum2-30-F-25
		2-30-PSV-11 on Debutanizer 2-30-D-5
		2-30-PSV-8 on Stabilizer Deethanizer2-30-D-4
		2-30-PSV-44 on Debutanizer Ovhd line2-30-D-5
		2-30-PSV-59 on Debutanizer Reboiler2-30-E-33 (T) outlet
		2-30-PSV-5 on Naphtha Deethanizer2-30-D-2
		2-30-PSV-6A on Naphtha Fractionator2-30-D-3
		2-30-PSV-6B on Naphtha Fractionator2-30-D-3
		2-30-PSV-68 on Propane Dryer2-30-D-7
		2-30-PSV-37 on Misc. Off-Gases Scrubber2-30-F-2

		2-30-PSV-58 on Debutanizer Reboiler2-30-E-24 (S) outlet
		2-30-PSV-14 on Depropanizer2-30-D-6
		2-30-PSV-45 on Depropanizer Ovhd line2-30-D-6
		2-30-PSV-60 on C3/C4 Charge to Deprop2-30-E-11A/B (S) outlet
		2-30-PSV-73 on Naph Fractionator Bottoms2-30-E-34 (S) inlet
	2 Pump Seals	2-30-G-31Pump Seal
		2-30-G-32Pump Seal
	3 Sample Stations	Sample Station Deprop Btms (Butane)
		Sample Station Absorber Off-gas
		Sample Station Propane Dryer Outlet
Alky (Qs)	**Sources**	**Detailed Source Description**
$Q_{(DIB)}$ DIB Header	7 PSVs	2-27-PSV-89 on Deisobutanizer Ovhd line 2-27-D-11
		2-27-PSV-90 on Deisobutanizer Ovhd line 2-27-D-11
		2-27-PSV-93 on Deisobutanizer Bottoms 2-27-E-32 (S) inlet
		2-27-PSV-99 on Deisobutanizer Ovhd 2-27-E-33F (S) inlet
		2-27-PSV-98 on Deisobutanizer Ovhd 2-27-E-33C (S) inlet
		2-27-PSV-97 on Deisobutanizer Ovhd 2-27-E-33A (S) inlet
		2-27-PSV-95 on Deisobutanizer Ovhd Acc 2-27-F-35
	6 Block Valves	Block Valve on 1" from DIB Ovhd pump seals
		Block Valve on 1 1/2" bypass around PSV-89 DIB Ovhd
		Block Valve on 1 1/2" bypass around PSV-90 DIB Ovhd
		Block Valve on 3/4" from DIB Reboilers
		Block Valve on 3/4" Vent from DIB Sample Stations
		Block Valve on 1 1/2" bypass around PSV-95 F-35 DIB ovhd Acc
	3 Sample Stations	3/4" line from DIB Overhead sample vent
		3/4" DIB analyzer vent
		Deisobutanizer Bottoms Sample vent
Q(#3) #3 Crude Hot Blowdown Header	28 PSVs	2-23-PSV-253 on Kerosene Exchanger 2-23-E-107 (S) inlet
		2-23-PSV-255 on Raw Crude 2-23-E-117A/B (T) outlet
		2-23-PSV-42 on 1st Stage Desalter 2-23-ES-2
		2-23-PSV-124 on 2ndStage Desalter 2-23-ES-3
		2-23-PSV-241 on Preflash Tower Top 2-23-D-10
		2-1-PSV-534 on Preflash Tower middle 2-23-D-10
		2-1-PSV-522 on Preflash Tower Ovhd line 2-23-D-10
		2-23-PSV-15 on Crude Tower above FZ 2-23-D-4
		2-23-PSV-16 on Crude Tower above FZ 2-23-D-4
		2-23-PSV-17 on Crude Tower above FZ 2-23-D-4
		2-23-PSV-21 on Crude Tower above 2-23-D-4
		2-23-PSV-254 on Diesel Product 2-23-E-30/70 (S) outlet
		2-23-PSV-283 on 3" line from 23-E-135B 23-E-135B
		2-23-PSV-282 on 3" line from 23-E-135A 23-E-135A
		2-23-PSV-285 on 3" line from 23-E-136B 23-E-136-B
		2-23-PSV-284 on 3" line from 23-E-136A 23-E-136A
		2-1-PSV-552 on 2" line from 1-E-96 Cy. Stock 1-E-96
		2-26-PSV-88 on 2" line from Hot Well RV 2-26-F-11
		2-23-PSV-101 on 3/4" line from Diesel Slop line
		2-23-PSV-237 on turbine for upper side cut pump 2-23-GT-30

		2-26-PSV-104 on Light Vacuum Gas Oil 2-26-E-22/24 (T) inlet
		2-26-PSV-120 on CS pump Seal Pot 2-26-F-138
		2-23-PSV-115 on Vac Btms pump Seal Pot 2-23-F-42A
		2-23-PSV-113 on Vac Btms pump Seal Pot 2-23-F-42B
		2-23-PSV-119 on Vac Btms pump Seal Pot 2-23-F-43A
		2-23-PSV-117 on Vac Btms pump Seal Pot 2-23-F-43B
		2-26-PSV-93 on Fuel Gas KO Pot 2-26-F-14
		2-23-PSV-168 on Fuel Gas KO Pot 2-23-F-21

Alky (Qs)	Sources	Detailed Source Description
Q(#3) #3 Crude Hot Blowdown Header	64 Block Valves	Block on Bypass around 2-23-PSV-253 2-23-E-107 (S) inlet
		Block on Bypass around 2-23-PSV-255 2-23-E-117A/B (T) outlet
		Block on 1st Stage Desalter vent 2-23-ES-2
		Block on Preflash Ovhd Off-gas 2-23-F-32 (1-F-3??)
		Block on Bypass around 2-23-PSV-15 2-23-D-4
		Block on Bypass around 2-23-PSV-16 2-23-D-4
		Block on Bypass around 2-23-PSV-17 2-23-D-4
		Block on Bypass around 2-23-PSV-21 2-23-D-4
		Block on Bypass around 2-23-PSV-254 2-23-E-30/70 (S) outlet
		Block Valve on 3/4" Hot Well vent line
		Block Valve on 2" line discharge from Pumpout pump on old "B" side
		Block on Bypass around 2-23-PSV-237 2-23-D-4
		Block on 2" downstream side of FC-95 back pressure controller
		Block on 2" tube side of E-112 (Lower Side Reflux)
		Block on 2" shell side of E-112 (Desalted Crude)
		Block on 2" shell side of E-113C (Desalted Crude)
		PSV Bypass Block on Fuel Gas KO Pot 2-26-F-14
		Block on 2" tube side of E-113C (Heavy Vacuum Gas Oil)
		Block on 2" shell side of E-113B (Desalted Crude)
		Block on 2" tube side of E-113B (Heavy Vacuum Gas Oil)
		Block on 2" tube side of E-110 (Heavy Vacuum Gas Oil)
		Block on 2" shell side of E-110 (Desalted Crude)
		Block on 2" shell side of E-110 (Desalted Crude)
		Block on 2" tube side of E-108 (Raw Crude)
		Block on 2" shell side of E-108 (Light Vacuum Gas Oil)
		Block on 2" tube side of E-115 (Heavy Gas Oil)
		Block on 2" shell side of E-115 (Pre Flash Bottoms)
		Block on 2" tube side of E-109 (Raw Crude)
		Block on 2" shell side of E-109 (Upper Side Reflux)
		Block on 2" tube side of E-106 (Raw Crude)
		Block on 2" shell side of E-106 (Heavy Vacuum Gas Oil)
		Block on 2" tube side of E-114 (Heavy Vacuum Gas Oil)
		Block on 2" shell side of E-114 (Preflash Bottoms)
		Block on 2" tube side of E-123A (Vac Bottoms)
		Block on 2" tube side of E-123B (Vac Bottoms)
		Block on 2" tube sid eof E-128 (Vac Bottoms)
		Block on 2" shell side of E-23 (Light Vacuum Gas Oil)
		Block on 2" shell side of E-21 (Light Vacuum Gas Oil)
		Block on 2" Reduced Crude Manifold(Reduced Crude)
		Block on 2" from F-24,25,26,27 filters (Gas Oil) (Import Gas Oil)
		Block on 2" Crude unit Neshap sump
		Block on 2" East pumpout to B-3 and B-4 heaters
		Block on 4" F-21 Fuel Gas KO bottom blow down
		Block on bypass around PSV-168 F-21 fuel gas KO pot
		Block on 2" West pumpout to B-3 and B-4 heaters
		Block on 2" shell side of E-64,65 Diesel coolers

Alky (Qs)	Sources	Detailed Source Description
Q(#3) #3 Crude Hot Blowdown Header	64 Block Valves	Block on 2" tube side of E-107 (Raw Crude)
		Block on 2" tube side of E-117A (Raw Crude)
		Block on 2" tube side of E-117B (Raw Crude)
		Block on 2" shell side of E-107 (Kerosene)
		Block on 2" shell side of E-117A (Diesel)
		Block on 2" shell side of E-117B (Diesel)
		Block on 2" from 810 manifold
		Block on 8" bypass around PSV-21 (Crude Tower Flash Zone)
		Block on 6" Preflash off Gas Vent to Flare
		Block on 3/4" Vacuum Breaker on #4 Vac Tower
		Block on 2" B-6 heater drain lines
		PSV Bypass Block on Fuel Gas KO Pot 2-26-F-14
		Block on Fuel Gas KO Pot liq drain 2-26-F-14
		Block on Bypass Block Valve around 23-PSV-124 2-26-F-14
		Block on Fuel Gas KO Pot liq drain 2-26-F-21
		Block Valve on 2" line from 2-26-F-25 2-26-F-25
		Block Valve on 2" line from heater purge line reduced crude
		Block Valve on Discharge of 2-11-G-1 Pumpout pump 2-11-G-1
	5 Pump Seals	HGO pump Seal Pot 2-23-F-40A
		HGO pump Seal Pot 2-23-F-40B
		HGO pump Seal Pot 2-23-F-41A
		HGO pump Seal Pot 2-23-F-41B
		2" line from G-25 Seal Pot vent 23-G-25
Q(I-C4) Tank 840 I-C4	1 PSV	2-606-PSV-104 on Butane 840 Tank
	1 Pump Seal	Pump Seals Vent from 840tk Pump cases
	1 Block Valve	Block Valve Vent from 840tk Ball
Q(BH) Blender Header	4 PSVs	PSV 17 on37-FF-33 8" Blender Filter
		PSV 16 on37-F-32 8" Blender Filter
		PSV 10 on 3/4" Butane line from C4 balls to blender
		PSV 15 on37-FF-31 6" Blender Filter
	4 Block Valves	Block on 37-FF-33 3" Blender Filter
		Block on 37-F-32 3" Blender Filter
		Block Valve on 2" Manual Vent from Blender filters
		Block on 37-FF-31 2" Blender Filter
Q(C3/C4) Main C3/C4 Splitter Header	3 PSVs	2-2-PSV-119 on Main C3/C4 Splitter Ovhd 2-2-D-16
		2-2-PSV-123 on Condensate Pot 2-2-F-61
		2-2-PSV-124 on Main C3/C4 Splitter Ovhd 2-2-D-16
	Sample Station	Sample Station SAM 450 from C3/C4 Splitter
	1 Block Valve	Block on Main C3/C4 Splitter Ovhd 2-2-D-16
Miscellaneous	3 PSVs	2-24-PSV-121 on Oxidizer Vent liq KO Pot 2-24-F-77
		2-24-PSV-122 on Naphtha Collection Drum 2-24-F-81
		2-36-PSV-3 on Alky Feed Drum 2-36-F-1
	1 Block Valve	Block Valve on 5-F-23
	1 Sample Staton	Sample Station 2-D-16
	2 Pump Seals	Pump Seal 36-G-1A
		Pump Seal 36-G-1B

Header Flow	Flow Estimate (scfd)	Basis For Estimate
Q(I-C4) Tank 840 I-C4 Header	539,256	Tracerco Survey
Q(#3) #3 Crude Hot Blowdown Header	218,112	Tracerco Survey
Q(Hydro) Hydrog Header	82,000	Tracerco Survey distributed using component counts
Q(LGC_S) LGC Spltr, Stranded Gas	145,000	Tracerco Survey distributed using component counts
Q(LGC_M) LGC Main DeC4 Header	62,000	Tracerco Survey distributed using component counts
Q(AA) Alky Acid Header	44,000	Tracerco Survey distributed using component counts
Q(ANA) Alky Non-Acid Header	89,000	Tracerco Survey distributed using component counts
Q(SG) Sat Gas Header	85,000	Tracerco Survey distributed using component counts
Q(DIB) DIB Header	30,000	Tracerco Survey distributed using component counts
Q(C3/C4) Main C3/C4 Splitter Header	13,000	Tracerco Survey distributed using component counts
Q(C4) C4 Sphere Header	73,000	Tracerco Survey distributed using component counts
Q(BH) Blender Header	1,000	AP-42 Equipment Leak Emission Factors

Appendix G

MPC Root Cause Analysis Procedure

1.0 PURPOSE

Flare systems are essential refinery safety equipment used to combust gases that will otherwise be released to the environment. This document describes incident investigation requirements for refinery flaring incidents. The purpose of the investigations is to:

1.1 Identify causes of the flaring event.

1.2 Identify steps taken to limit the duration of the flaring event and minimize emissions due to flaring.

1.3 Describe measures that will be taken to reduce the likelihood of a similar incident in the future.

2.0 SCOPE

The scope of this guideline applies to all four refinery flares at Marathon Catlettsburg Refinery. It has been developed to comply with the following regulations:

2.1 Marathon's Flare Consent Decree

2.2 Subpart Ja of the Federal New Source Performance Standards

2.3 Section 304 of the Emergency Planning and Community Right-to-Know Act (EPCRA)

3.0 SUMMARY

This guideline is divided into the following sections:

3.1 Reportable Incident Defined

3.2 Event-Specific Investigations

3.3 Schedule for Completion

3.4 Overlapping Requirements

4.0 REPORTABLE INCIDENT DEFINED

Event-specific investigations are required for flaring events if:

4.1 Greater than 500 pounds of sulfur dioxide are emitted in a 24-hour period.

4.2 Greater than 500 pounds of VOC are emitted in a 24-hour period.

4.3 Greater than 100 pounds but less than 500 pounds of VOC are emitted in a 24-hour period.

4.3.1 Investigations are required after 28 instances of flaring events between 100 and 499 pounds of VOC within a consecutive twelve month period.

4.3.2 Investigation are required for all such incidents within the next six month period.

4.3.3 At the end of the six month period a new twelve month period for counting instances will begin.

4.3.4 The Flare Systems Coordinator will be responsible for establishing and maintaining the tracking system for flaring events between 100 and 499 pounds of VOC.

4.3.5 All events that require root cause analysis will be entered into the KMS system.

4.4 Greater than 500,000 standard cubic feet of waste gas are vented to the flare systems in a 24-hour period.

"Waste gas" does not include gas introduced to the flare system exclusively to make it operate safely and as intended. "Waste gas" does not include pilot gas, steam, assist air or the minimum amount of purge and sweep gas that is necessary for safe operation.

"Waste gas" does not include gas introduced to the flare system to comply with regulatory requirements. As a result, supplemental gas added to the flare to comply with the net heating value requirement is not included.

"Waste gas" does not include hydrogen, nitrogen, oxygen, carbon monoxide, carbon dioxide or steam. The contribution of these materials may be excluded from waste gas calculations if the flare system has instrumentation capable of measuring the volumetric flow rates.

Calculations to determine whether the triggering level of flow has occurred will exclude the Baseload Waste Gas Flow Rate that has been identified for each flare system. The purpose of this exclusion is to focus investigations on incidents associated with periods of startup, shutdown and malfunction.

Calculations to determine whether the triggering level of flow has occurred will exclude any flare system where the Baseload Waste Gas Flow Rate has not been determined, until the end of the time period allowed for determining the Baseload Waste Gas Flow Rate.

Calculations to determine whether the triggering level of flow or emissions have occurred will include all of the flare systems added together unless the root cause(s) of the flaring are not related to each other.

Events having the same root cause(s) that last more than 24 hours will be investigated as a single incident.

For any flaring event that lasts longer than 24 hours, each calendar day will constitute a separate event when counting instances between 100 and 499 pounds of VOC.

5.0 EVENT-SPECIFIC INVESTIGATION

Investigations for the reportable flaring events will include the following information:

5.1 The date and time that the flaring event started and ended.

5.2 The total quantity of gas flared during the event.

5.3 An estimate of the quantity of sulfur dioxide and VOC that was emitted and the calculations used to determine the quantities.

5.4 The steps taken to limit the duration of the flaring event or the quantity of emissions associated with the event.

5.5 A detailed analysis that sets forth the root cause and all significant contributing causes of the flaring event to the extent determinable.

5.6 An analysis of the measures, if any, available to reduce the likelihood of a recurrence of a flaring event resulting from the same root cause or significant contributing causes in the future.

5.7 A demonstration that the actions taken during the flaring event are consistent with the procedures specified in the Flare Minimization and Sulfur Shedding plans, as appropriate.

5.8 If the actions taken during the flaring event are not consistent with the procedures specified in the appropriate plan, a discussion of actions taken and reasons why the plan was not followed.

Note: If a reportable flaring event has the same root cause(s) as a previously-reported incident, the prior report may be utilized in lieu of completing a repeat investigation.

6.0 SCHEDULE FOR COMPLETION

6.1 Event-specific investigation reports must be completed within 45 calendar days after the flaring event.

6.2 Corrective actions from the investigations will be implemented as expeditiously as possible, consistent with good engineering practices.

6.3 Outstanding actions will be tracked through completion.

6.4 A summary report with the following information will be submitted every six months:

6.4.1 The number of reportable flaring incidents that occurred during the period.

6.4.2 The date and duration of each event.

6.4.3 The amount of sulfur dioxide and VOC released during each reportable flaring incident.

6.4.4 Root Cause(s) of the incident.

6.4.5 Corrective Action(s) completed.

6.4.6 Corrective Action(s) still outstanding.

6.4.7 An analysis of any trends in the number of incidents, root causes or types of corrective action.

6.5 Investigation and Semi-Annual Summary Reports will be submitted to:

Kentucky Division of Air Quality

U.S. Environmental Protection Agency

7.0 OVERLAPPING REQUIREMENTS

7.1 Marathon's Petroleum Refinery Initiative (PRI) Consent Decree

Acid Gas and Hydrocarbon flaring events that are currently being tracked and reported under the PRI Consent Decree will continue to be reported using those procedures, for as long as the PRI Consent Decree remains in effect.

7.2 Subpart Ja of the Federal New Source Performance Standards

Subpart Ja is expected to include provisions for flare management plans. This guideline will be updated to incorporate the Ja requirements after the final rule is promulgated.

7.3 Section 304 of the Emergency Planning and Community Right-to-Know Act (EPCRA)

EPCRA incidents include all sources of excess emissions, including but not limited to flare releases. EPCRA reporting is not addressed in this procedure.

8.0 REFERENCES

8.1 40 CFR Part 60, NSPS Subpart Ja

8.2 New Source Review Consent Decree

8.3 40 CFR Part 355

9.0 List of Root Cause Analysis

Lube Flare Exceeds SO_2 Limit

Start time: 1/18/2014 7:45 am

End time: 1/19/2014 4:45 pm

Description: Several units on the north end were upset and relieving to the flare. The inner ring fuel gas pressure in the Sat Gas Naphtha Fractionator Reboiler began to drop due to a malfunction with the pressure regulator valve. While Operations was attempting to take the heater down due to unstable inner ring burner conditions, the main fuel gas high pressure NTE was hit and the ESD system shut the heater down. Hours later, Operations began the heater relighting process for the second time and the Naphtha Fractionator began to pressure up. To avoid hitting a high pressure NTE, which was done during the first attempt of relighting the heater, a vent to the Lube Flare on top of the Naphtha Fractionator Reflux Drum was opened and closed to manually control pressure in the Naphtha Fractionator. The No.5 Crude Board Operator began to observe high H_2S concentrations in the flare and notified the Lead Shift Foreman.

SO_2 Estimate/Refinery Process Gas Flared:

Date	Refinery Process gases Flared (MMSCFD)	Total SO_2 from Flares (lb/ rolling 24 hour)
1/18/14 7:45 AM	9.73	909.15
1/18/14 8:45 AM	7.89	1291.58
1/18/14 9:45 AM	9.35	1509.40
1/18/14 10:45 AM	6.94	1718.16
1/18/14 11:45 AM	6.91	1740.81
1/18/14 12:45 PM	7.94	1789.70

Date	Refinery Process gases Flared (MMSCFD)	Total SO_2 from Flares (lb/ rolling 24 hour)
1/18/14 1:45 PM	7.92	1822.26
1/18/14 2:45 PM	7.38	1841.03
1/18/14 3:45 PM	7.52	1871.60
1/18/14 4:45 PM	7.48	1903.37
1/18/14 5:45 PM	7.31	1933.86
1/18/14 6:45 PM	7.15	1961.33
1/18/14 7:45 PM	7.08	1974.50
1/18/14 8:45 PM	7.08	1996.30
1/18/14 9:45 PM	6.97	2014.56
1/18/14 10:45 PM	6.95	2031.94
1/18/14 11:45 PM	6.77	2048.55
1/19/14 12:45 AM	6.51	2062.86
1/19/14 1:45 AM	6.71	2074.04
1/19/14 2:45 AM	6.40	2075.89
1/19/14 3:45 AM	6.43	2081.49
1/19/14 4:45 AM	6.41	2087.77
1/19/14 5:45 AM	6.23	2092.31
1/19/14 6:45 AM	6.27	2096.20
1/19/14 7:45 AM	6.23	1461.95
1/19/14 8:45 AM	6.45	1084.45
1/19/14 9:45 AM	6.46	869.94
1/19/14 10:45 AM	6.60	663.73
1/19/14 11:45 AM	6.54	643.84
1/19/14 12:45 PM	7.08	597.76
1/19/14 1:45 PM	7.42	570.07
1/19/14 2:45 PM	7.66	560.07
1/19/14 3:45 PM	7.44	538.33
1/19/14 4:45 PM	6.93	517.91

Total VOC from flares: 58.09 tons

Steps Takes (if any):
The units that were shut down were brought up as quick as possible.

Root Cause/Contributing Factors:

1) Lube Board Operator was not notified that the block valve was being opened. Due Date: 06/30/14
2) Inner ring fuel gas pressure regulator valve malfunctioned. Date: 5/31/14
3) Relit 2 of 8 main burners in B-1, causing pressure in Naphtha Fractionator to exceed NTE. Due Date: 5/31/14
4) Vent from fractionator reflux drum to Lube Flare was opened. Due Date: 6/30/14

Reduce Likelihood of Recurrence (if any)/Corrective Actions Required:

1) Action 1- Place green environmental tag and label on block valve on vent line from fractionator overhead receiver to Lube Flare stating "Do Not Open without Environmental (Radio 8A or on call environmental representative) and Lube Console Operator Notification".

2) Action 2 – Add step to heater relighting procedure and troubleshooting guide to Notify Alky board and open vent line to Sour Gas K.O. Pot if manual control of pressure in the Naphtha Fractionator is needed.

3) Action 3 – Conduct training for all outside operators and board console operators for each unit/area regarding flare emission limits and current line ups within each unit/area that can result in exceeding these limits. Include in this training the general concern of making manual field changes without board console operator notification

Shutdown of Tail Gas Compressor

Start Time: 1/23/2014 10:45 pm

End Time: 1/24/2014 11:45 pm

Description: The Tail Gas Compressor 1-36-GC-40 shutdown because of low make up water flow. The tail gas was routed to the VAC heater resulting in the 162 ppm of H_2S 3 hour average and the SO_2 to go above the 500 lbs/24 hours.

SO2 Estimate/Refinery Process Gas Flared:

Date	Refinery Process gases Flared (MMSCFD)	Total SO_2 from Flares (lb/ rolling 24 hour)
1/23/14 10:45 PM	14.83	522.45
1/23/14 11:45 PM	14.80	590.39
1/24/14 12:45 AM	15.03	628.51
1/24/14 1:45 AM	15.14	656.56
1/24/14 2:45 AM	15.26	679.89
1/24/14 3:45 AM	15.45	706.85
1/24/14 4:45 AM	15.38	718.11
1/24/14 5:45 AM	15.28	734.28
1/24/14 6:45 AM	14.39	744.05
1/24/14 7:45 AM	14.49	748.90
1/24/14 8:45 AM	14.42	752.00
1/24/14 9:45 AM	14.32	754.48
1/24/14 10:45 AM	14.06	760.37
1/24/14 11:45 AM	14.46	767.77
1/24/14 12:45 PM	14.76	772.21
1/24/14 1:45 PM	15.33	779.88
1/24/14 2:45 PM	15.81	782.03
1/24/14 3:45 PM	15.45	784.57
1/24/14 4:45 PM	15.07	787.15
1/24/14 5:45 PM	14.49	789.61
1/24/14 6:45 PM	14.78	791.48
1/24/14 7:45 PM	15.23	792.61
1/24/14 8:45 PM	15.82	775.42

1/24/14 9:45 PM	16.21	681.48
1/24/14 10:45 PM	16.11	568.94
1/24/14 11:45 PM	15.94	503.13

Total VOC from flares: 131.41 tons

Steps Takes (if any):
The outside operators wrapped 1-37-FT-110B with steam hoses and thawed the small bore piping to the flow transmitter. After flow readings returned to acceptable levels the compressor was restarted and returned to normal running condition.

Root Cause/Contributing Factors:

1) Failed Steam Tracer Root Cause: Problem not anticipated. Due Date: 10/1/14

Reduce Likelihood of Recurrence (if any)/Corrective Actions Required:

1) Repair/replace steam tracing and insulation on make-up water piping circuit to 1-37-GC-40 and also repair/replace the electrical tracing on the compressor.
2) Add 1-37-FT-100B to Winterization List

HPCCR B-1 Heater Mains Shutdown

Start Time: 1/30/2014 1:45 am

End Time: 1/30/2014 8:45 am

Description: HPCCR heater B-1 lost its mains due the outside operator attempting to switch Debutanizer bottoms pumps.

SO_2 Estimate/Refinery Process Gas Flared:

Date	Refinery Process gases Flared (MMSCFD)	Total SO_2 from Flares (lb/ rolling 24 hour)
1/30/14 1:45 AM	11.41	513.88
1/30/14 2:45 AM	11.80	520.73
1/30/14 3:45 AM	12.06	523.85
1/30/14 4:45 AM	11.81	526.61
1/30/14 5:45 AM	11.91	530.84
1/30/14 6:45 AM	12.11	534.15
1/30/14 7:45 AM	11.96	537.83
1/30/14 8:45 AM	15.27	529.32

Total VOC from flares: 13.08 tons

Steps Takes (if any):
102-G-4 Debute Btms pump was put back on. Board man blocked the mains in so that the shutdown CV would re-set. Once he had good flow thru B-1, the mains were put back on (Procedure 2102-202 B-1, Heater Hot Restart, after loss of mains only).

Root Cause/Contributing Factors:

1) Causal Factor: Pump coupling disk pack failed when switching pumps.

Reduce Likelihood of Recurrence (if any)/Corrective Actions Required:

1) Corrective Action: Repair pair disk pack. Due Date: Completed on 2-10-2014

Shutdown of Propane Plus Compressor

Start Time: 2/6/2014 6:45 pm

End Time: 2/7/2014 4:45 am

Description: The Propane Plus discharge temp took off causing a high pressure NTE on the absorber. Operator opened compressor spillback and NTE cleared before operator could find the prescribed action. The pressure was dropping along with compressor discharge temp, reset spillback setpoint to 65# then feed to compressor fell back off causing temperature increase and absorber pressure to increase.

SO_2 Estimate/Refinery Process Gas Flared:

Date	Refinery Process gases Flared (MMSCFD)	Total SO_2 from Flares (lb/ rolling 24 hour)
2/6/14 6:45 PM	11.63	510.08
2/6/14 7:45 PM	11.45	514.65
2/6/14 8:45 PM	11.08	514.71
2/6/14 9:45 PM	11.30	515.98
2/6/14 10:45 PM	11.03	516.99
2/6/14 11:45 PM	11.02	516.14
2/7/14 12:45 AM	11.03	514.53
2/7/14 1:45 AM	11.05	512.83
2/7/14 2:45 AM	11.14	506.09
2/7/14 3:45 AM	10.96	502.43
2/7/14 4:45 AM	10.87	500.93

Total VOC from flares: 236.15 tons

Steps Takes (if any):
Propane Plus Compressor shutdown following procedure ROP-1043-207-CB

Root Cause/Contributing Factors:

2) Causal Factor: Formation of scale inside of the valve inhibited movement (Preventative/Predictive Maintenance).

Reduce Likelihood of Recurrence (if any)/Corrective Actions Required:

2) Corrective Action: Evaluate water wash system for improved salt recovery Due Date: 12/31/2015
3) Add to RADAR to stroke 1043PC0002 and verify operability every 6 months Due Date : 12/31/2015
4) Implement any modifications to the water wash system based on Tech Service evaluation Due Date: 12:31/2015

Flaring 1-F-87 Stranded Gas Drum

Start Time: 2/28/2014 1:45 am

End Time: 3/2/2014 9:45 am

Description: When the DDS off gas was being routed to propane plus, the chain valve allowing the DDS off gas to route to the Stranded Gas Compressor was found to have been opened when the line was readied for service several hours earlier. This over-pressured F-87 causing it to vent.

SO_2 Estimate/Refinery Process Gas Flared:

Date	Refinery Process gases Flared (MMSCFD)	Total SO_2 from Flares (lb/ rolling 24 hour)
2/28/14 1:45 AM	21.14	593.79
2/28/14 2:45 AM	20.95	590.72
2/28/14 3:45 AM	21.27	586.58
2/28/14 4:45 AM	21.43	582.21
2/28/14 5:45 AM	21.21	576.44
2/28/14 6:45 AM	21.22	571.47
2/28/14 7:45 AM	19.74	569.60
2/28/14 8:45 AM	17.62	564.75
2/28/14 9:45 AM	16.87	557.20
2/28/14 10:45 AM	17.11	554.36
2/28/14 11:45 AM	16.54	552.87
2/28/14 12:45 PM	16.39	549.47
2/28/14 1:45 PM	16.82	547.50
2/28/14 2:45 PM	16.91	552.91
2/28/14 3:45 PM	16.16	553.31
2/28/14 4:45 PM	16.70	563.58
2/28/14 5:45 PM	16.37	646.83
2/28/14 6:45 PM	16.66	720.45
2/28/14 7:45 PM	16.29	782.99
2/28/14 8:45 PM	15.98	830.96
2/28/14 9:45 PM	17.06	944.79
2/28/14 10:45 PM	16.76	1029.84
2/28/14 11:45 PM	17.30	1116.66
3/1/14 12:45 AM	18.17	1189.90
3/1/14 1:45 AM	18.49	1249.65
3/1/14 2:45 AM	18.00	1303.84
3/1/14 3:45 AM	15.69	1350.34
3/1/14 4:45 AM	16.86	1379.14
3/1/14 5:45 AM	17.34	1438.51
3/1/14 6:45 AM	15.34	1462.41
3/1/14 7:45 AM	15.36	1473.49
3/1/14 8:45 AM	16.59	1492.28
3/1/14 9:45 AM	16.52	1513.26
3/1/14 10:45 AM	16.11	1523.38

Date	Refinery Process gases Flared (MMSCFD)	Total SO_2 from Flares (lb/ rolling 24 hour)
3/1/14 11:45 AM	16.77	1532.62
3/1/14 12:45 PM	17.02	1581.89
3/1/14 1:45 PM	17.66	1590.24
3/1/14 2:45 PM	19.07	1591.62
3/1/14 3:45 PM	17.03	1590.41
3/1/14 4:45 PM	15.79	1578.16
3/1/14 5:45 PM	16.58	1492.80
3/1/14 6:45 PM	14.40	1416.56
3/1/14 7:45 PM	17.04	1347.29
3/1/14 8:45 PM	16.45	1283.44
3/1/14 9:45 PM	16.37	1159.50
3/1/14 10:45 PM	14.38	1065.68
3/1/14 11:45 PM	16.64	973.50
3/2/14 12:45 AM	15.91	901.20
3/2/14 1:45 AM	14.68	833.77
3/2/14 2:45 AM	16.39	773.16
3/2/14 3:45 AM	15.33	716.81
3/2/14 4:45 AM	17.32	680.33
3/2/14 5:45 AM	17.61	615.00
3/2/14 6:45 AM	18.01	585.88
3/2/14 7:45 AM	16.75	564.33
3/2/14 8:45 AM	17.18	537.05
3/2/14 9:45 AM	17.88	510.88

Total VOC from flares: 121.71 tons

Steps Takes (if any):
Found the valve open on the DDS line and closed it. The pressure dropped immediately and flare valve was closed.

Root Cause/Contributing Factors:

1) Causal Factor: The Flare valve PC-518 was opened which lead to this flaring event.

Reduce Likelihood of Recurrence (if any)/Corrective Actions Required:

No corrective action required

Flaring 1-F-87 Stranded Gas Drum

Start Time: 3/5/2014 1:45 pm

End Time: 3/9/2014 7:45 am

Description:
The Alky Unit lost 36-G-7-A (Reboiler) and 36-G-8-A (Recycle). The operators had to shutdown 36-B-1 heater because of NTE's on the heater (due to the pumps going down). Due to the shutdown of 36-B-1 Heater the operators had to put the Alky on circulation until B-1 could be restarted.

SO_2 Estimate/Refinery Process Gas Flared:

Date	Refinery Process gases Flared (MMSCFD)	Total SO_2 from Flares (lb/ rolling 24 hour)
3/5/14 1:45 PM	21.60	505.67
3/5/14 2:45 PM	21.29	510.92
3/5/14 3:45 PM	14.81	513.99
3/5/14 4:45 PM	15.41	521.15
3/5/14 5:45 PM	21.35	524.62
3/5/14 6:45 PM	19.53	523.25
3/5/14 7:45 PM	17.78	523.74
3/5/14 8:45 PM	15.79	519.28
3/5/14 9:45 PM	15.28	513.34
3/5/14 10:45 PM	15.17	512.02
3/5/14 11:45 PM	15.91	507.15
3/6/14 12:45 AM	16.01	497.91
3/6/14 1:45 AM	15.79	487.31
3/6/14 2:45 AM	16.34	485.63
3/6/14 3:45 AM	18.60	503.04
3/6/14 4:45 AM	18.28	516.79
3/6/14 5:45 AM	17.90	528.54
3/6/14 6:45 AM	17.97	537.45
3/6/14 7:45 AM	17.50	543.37
3/6/14 8:45 AM	17.47	537.12
3/6/14 9:45 AM	17.77	533.48
3/6/14 10:45 AM	17.56	531.93
3/6/14 11:45 AM	17.78	532.82
3/6/14 12:45 PM	17.86	533.29
3/6/14 1:45 PM	17.76	530.94
3/6/14 2:45 PM	17.77	529.93
3/6/14 3:45 PM	17.62	542.54
3/6/14 4:45 PM	17.88	580.30
3/6/14 5:45 PM	16.25	647.58
3/6/14 6:45 PM	14.06	727.32
3/6/14 7:45 PM	17.13	792.40
3/6/14 8:45 PM	12.31	790.14

Date	Refinery Process gases Flared (MMSCFD)	Total SO_2 from Flares (lb/ rolling 24 hour)
3/6/14 9:45 PM	12.50	784.75
3/6/14 10:45 PM	12.49	781.79
3/6/14 11:45 PM	14.36	780.20
3/7/14 12:45 AM	15.90	805.12
3/7/14 1:45 AM	13.63	824.46
3/7/14 2:45 AM	12.25	824.05
3/7/14 3:45 AM	11.37	802.35
3/7/14 4:45 AM	10.84	780.44
3/7/14 5:45 AM	9.77	760.55
3/7/14 6:45 AM	10.15	746.48
3/7/14 7:45 AM	8.88	733.79
3/7/14 8:45 AM	9.51	740.57
3/7/14 9:45 AM	9.55	736.93
3/7/14 10:45 AM	9.67	750.41
3/7/14 11:45 AM	9.22	766.12
3/7/14 12:45 PM	9.01	786.02
3/7/14 1:45 PM	9.15	809.13
3/7/14 2:45 PM	8.65	828.12
3/7/14 3:45 PM	8.26	832.63
3/7/14 4:45 PM	8.12	802.93
3/7/14 5:45 PM	7.90	731.49
3/7/14 6:45 PM	7.56	650.19
3/7/14 7:45 PM	7.37	580.81
3/7/14 8:45 PM	8.05	582.56
3/7/14 9:45 PM	7.75	600.23
3/7/14 10:45 PM	7.87	623.60
3/7/14 11:45 PM	7.87	623.60
3/8/14 12:45 AM	8.45	647.80
3/8/14 1:45 AM	8.32	643.16
3/8/14 2:45 AM	8.58	642.09
3/8/14 3:45 AM	8.17	658.38
3/8/14 4:45 AM	8.10	679.97
3/8/14 5:45 AM	8.03	697.57
3/8/14 6:45 AM	8.11	716.63
3/8/14 7:45 AM	8.23	732.19
3/8/14 8:45 AM	8.68	749.58
3/8/14 9:45 AM	8.68	755.01
3/8/14 10:45 AM	9.64	772.85
3/8/14 11:45 AM	10.99	778.85
3/8/14 12:45 PM	11.50	776.29
3/8/14 1:45 PM	11.60	760.21
3/8/14 2:45 PM	11.69	736.76
3/8/14 3:45 PM	12.06	717.81

Date	Refinery Process gases Flared (MMSCFD)	Total SO_2 from Flares (lb/ rolling 24 hour)
3/8/14 4:45 PM	11.70	702.85
3/8/14 5:45 PM	11.18	698.85
3/8/14 6:45 PM	20.97	708.99
3/8/14 7:45 PM	15.53	713.60
3/8/14 8:45 PM	19.46	717.16
3/8/14 9:45 PM	12.27	714.05
3/8/14 10:45 PM	11.34	701.16
3/8/14 11:45 PM	11.77	680.27
3/9/14 12:45 AM	11.27	658.04
3/9/14 1:45 AM	10.67	636.36
3/9/14 2:45 AM	10.30	600.74
3/9/14 3:45 AM	10.28	579.13
3/9/14 4:45 AM	10.56	554.86
3/9/14 5:45 AM	10.94	536.61
3/9/14 6:45 AM	10.73	517.17
3/9/14 7:45 AM	10.70	500.60

Total VOC from flares: 216.21 tons

Steps Takes (if any):
Operators followed procedures to get the unit in a safe and controlled state by putting the Alky on circulation.

Root Cause/Contributing Factors:
1) Causal Factor: The pumps going down caused the 36-B-1 Heater to shutdown

Reduce Likelihood of Recurrence (if any)/Corrective Actions Required:
No corrective action required

Loss of Electricity on the South End

Start Time: 3/12/2014 1:45 pm

End Time: 3/15/2014 2:30 pm

Description:
This caused the loss of power to the following units: #5 Crude, #5 Vac, LEP, Cumene, LPCCR, Lube Plant Control Room, PetroChem Control Room and MOAB Boiler. This also caused the #3 Crude Unit to reduce rates because of the loss of three of the unit charge pumps. The entire refinery's throughput was reduced with this incident. Around 6:00 AM, the fault was isolated and power restored to the affected units.

SO_2 Estimate/Refinery Process Gas Flared:

Date	Refinery Process gases Flared (MMSCFD)	Total SO_2 from Flares (lb/ rolling 24 hour)
3/12/14 8:30 AM	11.25	513.23
3/12/14 9:30 AM	8.71	572.04
3/12/14 10:30 AM	7.5	601.08
3/12/14 11:30 AM	8.53	603.69
3/12/14 12:30 PM	7.62	615.99
3/12/14 1:30 PM	8.27	631.12
3/12/14 2:30 PM	9.65	631.08
3/12/14 3:30 PM	9.2	659.56
3/12/14 4:30 PM	8.66	678.84
3/12/14 5:30 PM	9.24	681.31
3/12/14 6:30 PM	9.29	676.23
3/12/14 7:30 PM	9.5	670.41
3/12/14 8:30 PM	10.36	665.03
3/12/14 9:30 PM	10.21	661.39
3/12/14 10:30 PM	8.93	657.52
3/12/14 11:30 PM	9.13	652.44
3/13/14 12:30 AM	8.39	646.5
3/13/14 1:30 AM	8.88	649.54
3/13/14 2:30 AM	9.92	653.23
3/13/14 3:30 AM	15.41	656.56
3/13/14 4:30 AM	8.25	724
3/13/14 5:30 AM	7.95	778.68
3/13/14 6:30 AM	8.11	834.07
3/13/14 7:30 AM	8.26	859.19
3/13/14 8:30 AM	8.72	928.73
3/13/14 9:30 AM	7.07	992.47
3/13/14 10:30 AM	7.33	1084.68
3/13/14 11:30 AM	7.65	1196.92
3/13/14 12:30 PM	8.04	1315.71
3/13/14 1:30 PM	8.69	1419.71
3/13/14 2:30 PM	8.03	1532.08
3/13/14 3:30 PM	8.88	1616.23
3/13/14 4:30 PM	8.99	1717.55
3/13/14 5:30 PM	8.08	1817.29
3/13/14 6:30 PM	7.72	1931.39
3/13/14 7:30 PM	7.36	2036.64
3/13/14 8:30 PM	7.25	2144.63
3/13/14 9:30 PM	7.08	2246.48
3/13/14 10:30 PM	7.89	2339.58
3/13/14 11:30 PM	7.44	2446.28
3/14/14 12:30 AM	7.73	2559.72
3/14/14 1:30 AM	8.66	2655.24

Date	Refinery Process gases Flared (MMSCFD)	Total SO_2 from Flares (lb/ rolling 24 hour)
3/14/14 2:30 AM	9.13	2749.92
3/14/14 3:30 AM	9.09	2846.32
3/14/14 4:30 AM	9.53	2891.57
3/14/14 5:30 AM	9.8	2985.53
3/14/14 6:30 AM	13.02	3115.41
3/14/14 7:30 AM	13.06	3178.7
3/14/14 8:30 AM	12.04	3204.04
3/14/14 9:30 AM	12.91	3232.52
3/14/14 10:30 AM	12.1	3254.53
3/14/14 11:30 AM	13.05	3326.65
3/14/14 12:30 PM	11.36	3379.76
3/14/14 1:30 PM	11.34	3372.81
3/14/14 2:30 PM	11.19	3383.79
3/14/14 3:30 PM	13.19	3427
3/14/14 4:30 PM	13.14	3384.03
3/14/14 5:30 PM	13.96	3305.65
3/14/14 6:30 PM	13.15	3212.51
3/14/14 7:30 PM	12.08	3125.11
3/14/14 8:30 PM	11.5	3025.72
3/14/14 9:30 PM	10.92	2921.72
3/14/14 10:30 PM	11.07	2826.03
3/14/14 11:30 PM	11.05	2718.18
3/15/14 12:30 AM	11.42	2604.57
3/15/14 1:30 AM	11.36	2500.85
3/15/14 2:30 AM	11.47	2397.27
3/15/14 3:30 AM	11.89	2292.61
3/15/14 4:30 AM	11.42	2175
3/15/14 5:30 AM	11.59	2027.7
3/15/14 6:30 AM	11.53	1834.65
3/15/14 7:30 AM	11.13	1676.77
3/15/14 8:30 AM	11.39	1523.9
3/15/14 9:30 AM	11.61	1371.09
3/15/14 10:30 AM	11.3	1225.19
3/15/14 11:30 AM	11.24	1039.1
3/15/14 12:30 PM	10.91	858.43
3/15/14 1:30 PM	11.42	750.63
3/15/14 2:30 PM	10.99	631.75

Total VOC from flares: 130.26 tons

Steps Takes (if any):
Operators followed procedures to get the units back running.

Root Cause/Contributing Factors:

1) Causal Factor: 69 KV insulator on the Neal Plant section of the Catlettsburg Refinery 69 KV power grid faulted causing the loss of one electrical feed to the 69 KV Substation 905A. An improper operation of the 69 KV Indirect Line Differential Relay between 69 KV Substations 904B and 905A causing the loss of the other feed to 69 KV Substation 905A resulting in a complete outage of Substation 905A.

Reduce Likelihood of Recurrence (if any)/Corrective Actions Required:

No corrective action

Refinery-Wide Power Outage

Start Time: 6/10/2014 9:30 pm

End Time: 6/12/2014 1:30 am

Description:

Refinery-Wide power outage was triggered by a lightning strike.

SO_2 Estimate/Refinery Process Gas Flared:

Date	Refinery Process gases Flared (MMSCFD)	Total SO_2 from Flares (lb/ rolling 24 hour)
6/10/14 9:30 PM	23.66	533.61
6/10/14 10:30 PM	19.34	839.66
6/10/14 11:30 PM	15.55	1102.22
6/11/14 12:30 AM	4.88	1358.83
6/11/14 1:30 AM	9.02	1388.14
6/11/14 2:30 AM	4.71	1536.11
6/11/14 3:30 AM	4.85	1601.02
6/11/14 4:30 AM	7.75	1611.36
6/11/14 5:30 AM	4.55	1618.86
6/11/14 6:30 AM	4.22	1620.63
6/11/14 7:30 AM	6.45	1618.15
6/11/14 8:30 AM	5.58	1625.20
6/11/14 9:30 AM	5.34	1638.30
6/11/14 10:30 AM	5.39	1632.53
6/11/14 11:30 AM	5.44	1624.54
6/11/14 12:30 PM	5.89	1617.90
6/11/14 1:30 PM	7.69	1679.48
6/11/14 2:30 PM	8.52	1719.78
6/11/14 3:30 PM	8.82	1716.98
6/11/14 4:30 PM	9.17	1731.32
6/11/14 5:30 PM	8.93	1734.24
6/11/14 6:30 PM	8.42	1730.11
6/11/14 7:30 PM	8.45	1725.96
6/11/14 8:30 PM	8.71	1722.48
6/11/14 9:30 PM	8.81	1550.91

Date	Refinery Process gases Flared (MMSCFD)	Total SO_2 from Flares (lb/ rolling 24 hour)
6/11/14 10:30 PM	8.41	1237.39
6/11/14 11:30 PM	10.51	963.22
6/12/14 12:30 AM	9.37	691.09
6/12/14 1:30 AM	9.80	646.90

Total VOC from flares: 57.84 tons

Steps Takes (if any):
Operators followed procedures to get the units back running.

Root Cause/Contributing Factors:

1) Causal Factor: Lightning strike caused a power outage in the refinery

Reduce Likelihood of Recurrence (if any)/Corrective Actions Required:
No corrective action

Main Splitter RV lifting During Start-Up

Start Time: 6/15/2014 12:30 pm

End Time: 6/19/2014 6:30 pm

Description:
PSV (2-PSV-148) on the Main Splitter (2-D-16) relieved during startup. The PSV opened at a pressure less than the set point.

SO_2 Estimate/Refinery Process Gas Flared:

Date	Refinery Process gases Flared (MMSCFD)	Total SO_2 from Flares (lb/ rolling 24 hour)
6/15/14 12:30 PM	7.25	503.29
6/15/14 1:30 PM	7.36	515.18
6/15/14 2:30 PM	5.92	518.18
6/15/14 3:30 PM	6.30	527.68
6/15/14 4:30 PM	7.70	543.92
6/15/14 5:30 PM	7.20	579.11
6/15/14 6:30 PM	8.15	587.59
6/15/14 7:30 PM	6.01	595.58
6/15/14 8:30 PM	7.60	604.88
6/15/14 9:30 PM	8.06	628.78
6/15/14 10:30 PM	6.50	655.35
6/15/14 11:30 PM	6.79	684.91
6/16/14 12:30 AM	6.86	713.57
6/16/14 1:30 AM	6.13	740.12
6/16/14 2:30 AM	5.96	761.28
6/16/14 3:30 AM	5.66	758.65

Date	Refinery Process gases Flared (MMSCFD)	Total SO_2 from Flares (lb/ rolling 24 hour)
6/16/14 4:30 AM	6.40	749.87
6/16/14 5:30 AM	6.31	633.22
6/16/14 6:30 AM	6.20	627.77
6/16/14 7:30 AM	6.56	632.90
6/16/14 8:30 AM	6.03	636.99
6/16/14 9:30 AM	6.28	637.85
6/16/14 10:30 AM	4.81	627.29
6/16/14 11:30 AM	4.47	622.46
6/16/14 12:30 PM	6.36	609.07
6/16/14 1:30 PM	10.10	609.91
6/16/14 2:30 PM	9.01	616.84
6/16/14 3:30 PM	12.36	617.43
6/16/14 4:30 PM	15.63	621.17
6/16/14 5:30 PM	16.24	594.68
6/16/14 6:30 PM	10.91	613.82
6/16/14 7:30 PM	6.76	633.05
6/16/14 8:30 PM	6.37	666.09
6/16/14 9:30 PM	6.19	684.17
6/16/14 10:30 PM	6.31	696.89
6/16/14 11:30 PM	6.62	713.29
6/17/14 12:30 AM	8.57	734.74
6/17/14 1:30 AM	10.29	751.73
6/17/14 2:30 AM	9.65	780.77
6/17/14 3:30 AM	8.91	801.51
6/17/14 4:30 AM	9.24	822.48
6/17/14 5:30 AM	9.30	843.65
6/17/14 6:30 AM	8.58	868.82
6/17/14 7:30 AM	9.45	897.51
6/17/14 8:30 AM	9.60	934.26
6/17/14 9:30 AM	8.94	958.88
6/17/14 10:30 AM	7.31	980.22
6/17/14 11:30 AM	7.54	1007.50
6/17/14 12:30 PM	6.60	1033.05
6/17/14 1:30 PM	6.48	1050.78
6/17/14 2:30 PM	7.78	1075.89
6/17/14 3:30 PM	7.82	1111.10
6/17/14 4:30 PM	8.50	1136.81
6/17/14 5:30 PM	8.99	1180.12
6/17/14 6:30 PM	8.06	1205.01
6/17/14 7:30 PM	7.55	1232.39
6/17/14 8:30 PM	7.96	1244.21
6/17/14 9:30 PM	7.29	1254.76
6/17/14 10:30 PM	6.76	1262.15

Date	Refinery Process gases Flared (MMSCFD)	Total SO_2 from Flares (lb/ rolling 24 hour)
6/17/14 11:30 PM	7.10	1262.56
6/18/14 12:30 AM	6.82	1257.39
6/18/14 1:30 AM	6.40	1260.45
6/18/14 2:30 AM	5.50	1254.04
6/18/14 3:30 AM	4.92	1250.82
6/18/14 4:30 AM	5.32	1242.39
6/18/14 5:30 AM	5.15	1240.74
6/18/14 6:30 AM	4.91	1240.71
6/18/14 7:30 AM	6.07	1240.35
6/18/14 8:30 AM	6.19	1226.92
6/18/14 9:30 AM	7.44	1218.81
6/18/14 10:30 AM	7.02	1201.53
6/18/14 11:30 AM	6.84	1195.76
6/18/14 12:30 PM	5.14	1174.22
6/18/14 1:30 PM	5.20	1154.60
6/18/14 2:30 PM	5.55	1140.52
6/18/14 3:30 PM	5.58	1126.55
6/18/14 4:30 PM	5.39	1118.86
6/18/14 5:30 PM	3.87	1101.44
6/18/14 6:30 PM	3.85	1087.32
6/18/14 7:30 PM	4.61	1070.73
6/18/14 8:30 PM	4.07	1056.23
6/18/14 9:30 PM	4.01	1038.08
6/18/14 10:30 PM	3.85	1014.97
6/18/14 11:30 PM	3.97	995.90
6/19/14 12:30 AM	3.82	975.32
6/19/14 1:30 AM	3.64	954.59
6/19/14 2:30 AM	3.67	932.69
6/19/14 3:30 AM	3.33	920.50
6/19/14 4:30 AM	3.82	894.25
6/19/14 5:30 AM	3.64	859.97
6/19/14 6:30 AM	3.99	824.60
6/19/14 7:30 AM	3.40	788.58
6/19/14 8:30 AM	3.70	757.86
6/19/14 9:30 AM	4.15	732.93
6/19/14 10:30 AM	3.99	723.82
6/19/14 11:30 AM	4.92	694.79
6/19/14 12:30 PM	4.94	683.34
6/19/14 1:30 PM	4.91	668.00
6/19/14 2:30 PM	5.01	646.32
6/19/14 3:30 PM	4.89	618.59
6/19/14 4:30 PM	4.86	583.74
6/19/14 5:30 PM	8.53	551.72
6/19/14 6:30 PM	4.86	516.55

Total VOC from flares: 204.77 tons

Steps Takes (if any):
Operators bypassed feed to the main splitter.

Root Cause/Contributing Factors:
1) Causal Factor: The RV lifted less than the designed pressure set point sending gas to the flare.

Reduce Likelihood of Recurrence (if any)/Corrective Actions Required:
Replacement of the PSV will be looked into to ensure PSV does not relieve before specified set point.

Reoccuring SDA Shutdown of GC-17 Details

Start Time: 3/27/2014 6:45pm

End Time: 3/27/2014 6:51 pm

Description:

Unplanned Event: 2031-G-17 solvent compressor tripped off due to a high level in 2031-F-4 knock out pot.
Harm: The compressor was off line for 6 minutes. The compressor was vented to the flare during this time. Environmental was notified.
Description: The console operator was alerted via a Honeywell alarm of a high level in the knock out pot. The console operator opened the outlet valve to 100% and had the field operator open the bypass around the control valve and place the second knock out pot pump on line. The level continued to rise and the compressor tripped. Within 6 minutes the level had returned to normal and the compressor was re-started and has operated without incident since. (21 days as of this report)
NOTE: Operators suspected the foul water system had over pressured and ran the NNA foul water checklist to see if any water boots were blowing through. Nothing was found. Nothing was found on the foul water system PI data that pointed to a problem with the foul water system. The pumps were operating normally as well.

Steps Takes (if any):
Opened vent to flare while GC-17 was down, also put a second pump on. Once level came back down GC-17 was put back on and the vent was blocked back in. Environmental was notified of the venting from 6:45pm to 6:51pm, Ops are also trouble shooting as to why the level continued to fill with the CV 100% open and the By-pass opened.

Root Cause/Contributing Factors:
1) Causal Factor: The incident only lasted 6 minutes. PI data and after the fact trouble shooting did not uncover any definitive cause of this problem.

Reoccurring SDA Shutdown of GC-17

Start Time: 5/7/2014 10:15:00 AM

End Time: 5/7/2014 10:49 AM

Description:
While trouble shooting nuisance alarms on the machine, the reliability engineer found two loose wires on the 24v system. When he tightened the wires and re-applied the 24v back to the system the compressor shutdown.

Steps Takes (if any):
Re-set the bentley nevada rack and cleared the alarm. Ops secured the unit per ROP-2031-150-CB then restarted the machine.

Root Cause/Contributing Factors:
1) Causal Factor: Loose wires on the 24 volt system caused compressor shutdown.

Wet Gas Compressor Shutdown

Start Time: 5/14/2014 8:30:00 PM

End Time: 5/16/2014

Description:
At approximately 8:30 pm the Wet gas Compressor shut down due to high vibes and oil temperature causing the FCC unit to shutdown. The flare's flame was not visible for approximately 40 minutes. The flare outage will be investigated via INC-54730.

Steps Takes (if any):
Issued the 2 minute check, followed the Emergency shutdown procedure for the Wet Gas Compressor. Followed Shutdown procedures and lighting of the flare.

Root Cause/Contributing Factors:
1) Causal Factor: Wet Gas Compressor shutdown due to high oil temperature which lead to the FCC to shut down.

10.0 REVISION HISTORY

Revision Number	Description of change	Written by	Effective Date
0	Original Procedure	J. Fournier	3/7/2012
1	Updated with RCA Analysis	B. Bazemore	7/31/2014

Appendix H

NNA Updated Flare Data and Monitoring Systems and Protocol Report

Marathon Petroleum Company LP

CONFIDENTIAL BUSINESS INFORMATION
CONTAINS PROPRIETARY INFORMATION

Flare Data & Initial Monitoring Systems Report for the NNA Flare

Catlettsburg Refinery, LLC
Catlettsburg, Kentucky

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SECTION
Introduction

The Flare Data and Initial Monitoring Systems Report is being submitted for the NNA Flare located at Marathon Petroleum Company's (Marathon's) refinery in Catlettsburg, Kentucky (Catlettsburg) per the requirements of the June 19, 2011 DRAFT version of an anticipated Consent Decree between the United States and Marathon Petroleum Company.

Included within this document is specific design information regarding the Catlettsburg NNA Flare, the components of the flare system, and the monitoring systems that Marathon is planning to install as part of an automatic steam control system designed to mitigate periods of flare over-steaming by maintaining flare operation within a defined operating envelope. The specific numeric limits of this operating envelope remain under discussions between Marathon and the U.S. EPA.

The automatic steam control system to be implemented at the Catlettsburg NNA Flare is a combination of steam and waste gas flow meters, automated steam control valves and advanced control algorithms.

SECTION
Flare Design Components

The Catlettsburg New North Area (NNA) flare was installed in June 1970 and is currently equipped with a John Zink design tip. The original installation consisted of an elevated, steam-assisted, simple flare, and an ignition system. Also included was all piping for the steam ring, pilot gas, and three ignition tubes. The steam supply piping is 6 inch diameter pipe rated for up to 450 pounds of steam. The most recent physical changes to the flare involved replacement of the flare tip in 1999 with a John Zink model STF-S-36 flare tip assembly. A copy of the facility plot plan showing the location of the New North Area flare is included as Figure 2-1.

Flare Component Details

Flare Stack

The elevated NNA flare stack consists of a 36 inch diameter flare riser at a length of 185 feet. The total height of the flare stack assembly is 197.19 feet, and is self-supported.

Flare Tip

The STF-S-36 flare tip assembly was installed in November 1998 by John Zink. The flare tip has a diameter of 36 inches and a length of 12 feet 3 inches. It includes a 6 inch upper steam manifold connection, including an upper steam ring, steam risers, and steam spider tips. The 6 inch steam riser splits into 39 steam jets. Also included is a 2 inch pilot gas manifold connection with three 1 inch pilot and ignition gas connections. A copy of the flare tip drawing is included in Appendix B.

Knockout Drums

The NNA flare is fed from two primary headers with a main knockout drum on each header. The NNA flare header feeds into the 'New' New North Area flare drum (11-F-14), which is a horizontal vessel with an internal diameter of 12 feet, and a nominal length of 36 feet. The NNA flare header also feeds into the 'Old' New North Area flare drum (11-F-9) which is a horizontal vessel with an internal diameter of 9 feet 10.75 inches, and a nominal length of 36 feet. Two smaller knockout drums are located on unit subheaders and include the SDA flare drum (31-F-27) and DDS flare drum (31-F-5).

Flare Header

The NNA flare header is outlined in the Simplified Schematic included as Figure 2-2. The flare header consists predominantly of two sections: the old NNA branch to the #3 Crude relief as well as to the #2 SRU header and the new NNA to the DDS header . The #2 SRU flare header along with the Propane Bullet flare header and the #3 Crude relief header flow to the "Old" NNA flare drum and into the NNA flare. In the second section the SDA flare drum, #1 SRU Flare Header, Isom unit flare header, LPVGO plant flare header, Hydrogen plant flare header, 18 inch KDS flare header, NPT flare header 12 inch KDS flare Header , and the HPVGO flare header flow into the "New" NNA flare drum (11-F-14) and to the NNA flare. Also, the #2 SRU header and the #3 Crude header are inter connected at two points and can go to the Alky flare during NNA outages.

Sweep Gas System

The flare tip assembly design specifications suggest that a continuous sweep is included to prevent air infiltration into the flare system. The recommended sweep volume is 434 standard cubic foot per hour (scfh) and can be any gas that does not contain oxygen or go to dew point during normal operating conditions. There are two 1.5 inch fuel gas sweeps with orifice plates near the base of the flare stack to maintain positive flow in the two main flare headers. To help to maintain steady flow on the flare, on of the two supplemental gas is used as a sweep to the flare to prevent smoking and loss of flare.

Purge Gas System

The NNA flare is not equipped with a water seal in the stack and thus does not have a purge gas system.

Pilot Gas System

The pilot gas system is included as part of the flare tip assembly, and includes a 4 inch connection to the pilot gas supply line, which splits into three ½ inch risers to the top of the flare tip. The pilot orifice is drilled to allow for 85 scfh per pilot, for a total of 255 scfh of natural gas.

Supplemental Gas System

Supplemental natural gas is added to the NNA flare header just downstream of the NNA flare knockout drum and before the flow analyzers in order to ensure that the net heating value limitations are continuously met.

Assist System

The NNA flare is steam assisted using a minimum steam flow of 780 lb/hr, and a maximum steam flow of 76,140 lb/hr.

Ignition System

The ignition system consists of an explosion-proof and weather-proof panel for 3 pilots. This panel includes needle valves and pressure gauges for control of air and gas flow, a spark plug, a spark sight port, and an explosion-proof button.

Flare Design Parameters

Table 2-1 NNA Flare Design Information

Catlettsburg NNA Flare	**MPC Equipment ID = 2-11-FS-002**		
Flare Tip Details			
Flare Tip Manufacturer	John Zink		
Flare Tip Installation Date	1998		
Flare Tip Size	33 in diameter		
Flare Tip Model Number	STF-S-36		
Summary of Flare Design Parameters			
Parameter	***Value***	***Units***	***Source***[1]
Design Sweep Rate	434	scfh	Flare Tip Drawing
Maximum Sweep Rate	1545 (72.06 lb/hr at 18 MW and 386 scf/lbmol)	scfh	Fuel Gas Sweep Tag No. 2011-RO -212
Maximum Supplemental Gas Rate	1500	scfh	Design Engineering Estimate
Maximum Pilot Rate	150	scfh	Flare Tip Drawing
Minimum Total Steam	780	lb/hr	Process Design Basis Flare Instrumentation Implementation Phase
Maximum Hydraulic Capacity (i.e. Max Vent Gas Rate)	710,000	lb/hr	Original Flare Design Data
Maximum Smokeless Capacity	143,000	lb/hr	Piping & Instrumentation Diagram Flare system NA/NNA

Notes:

1. A copy of the Drawings, Original Design Data, and the Engineering Estimates can be found in Appendix B.

Figure 2-1
Facility Plot Plan

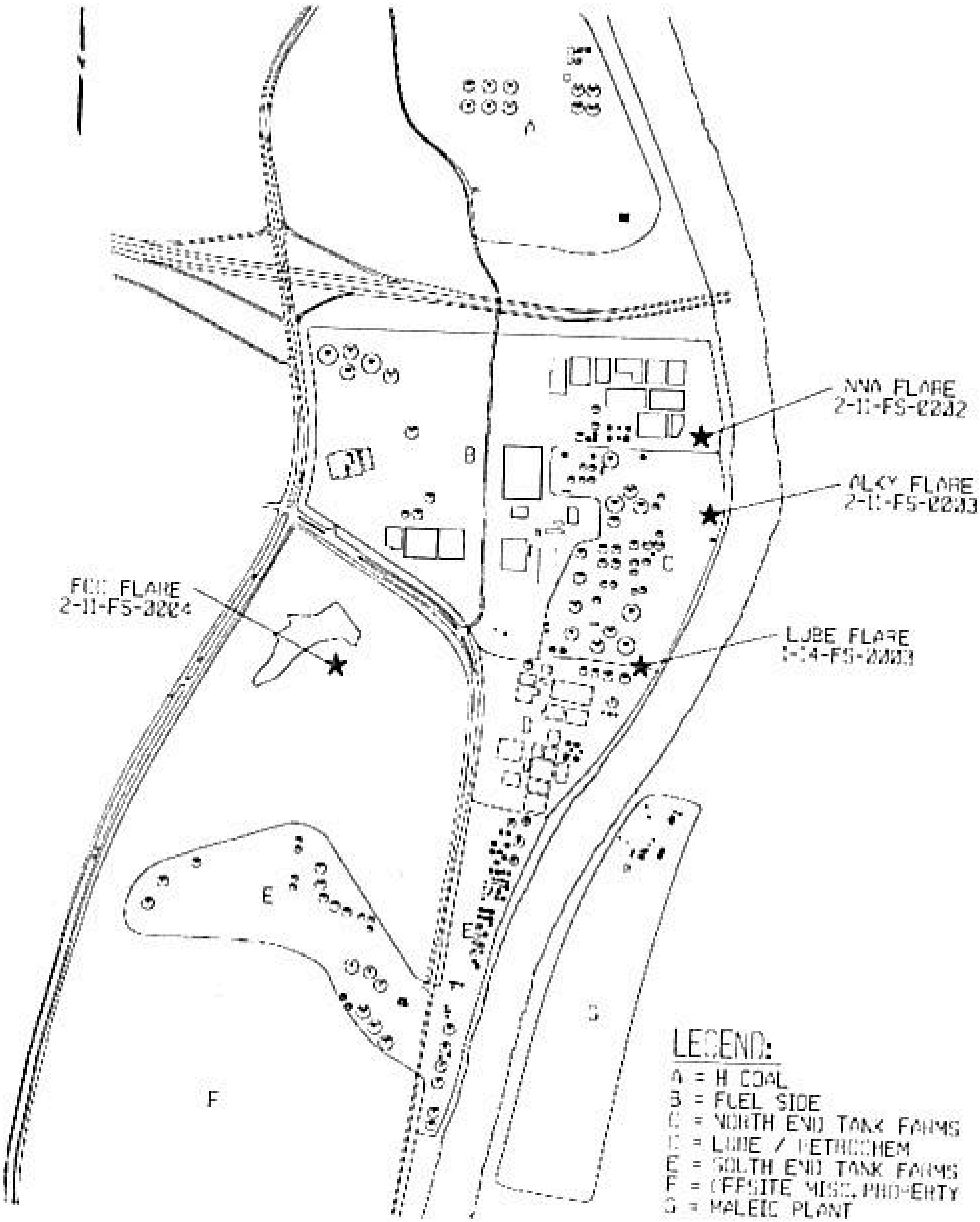
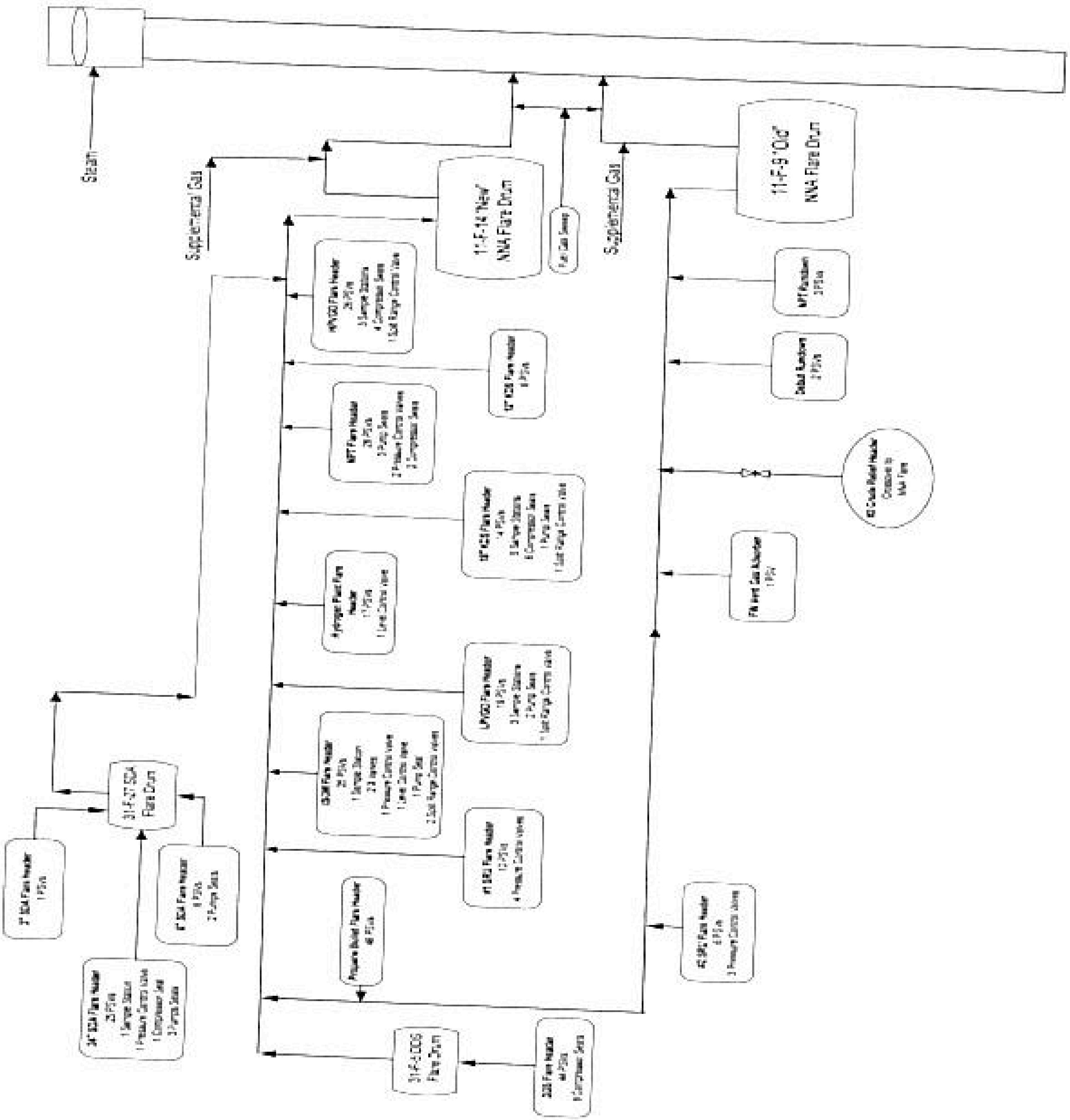


Figure 2-2
NNA Flare Simplified Schematic


Steam
Supplemental Gas
11-F-14 "New" NNA Flare Drum
Supplemental Gas
11-F-9 "Old" NNA Flare Drum
31-F-27 SGA Flare Drum
31-F-5 DDS Flare Drum

Non- Routine/Non-PSV Flare Sources

There are 11 pressure control valves, 2 level control valves, and 5 split range control valves located on the NNA flare system.

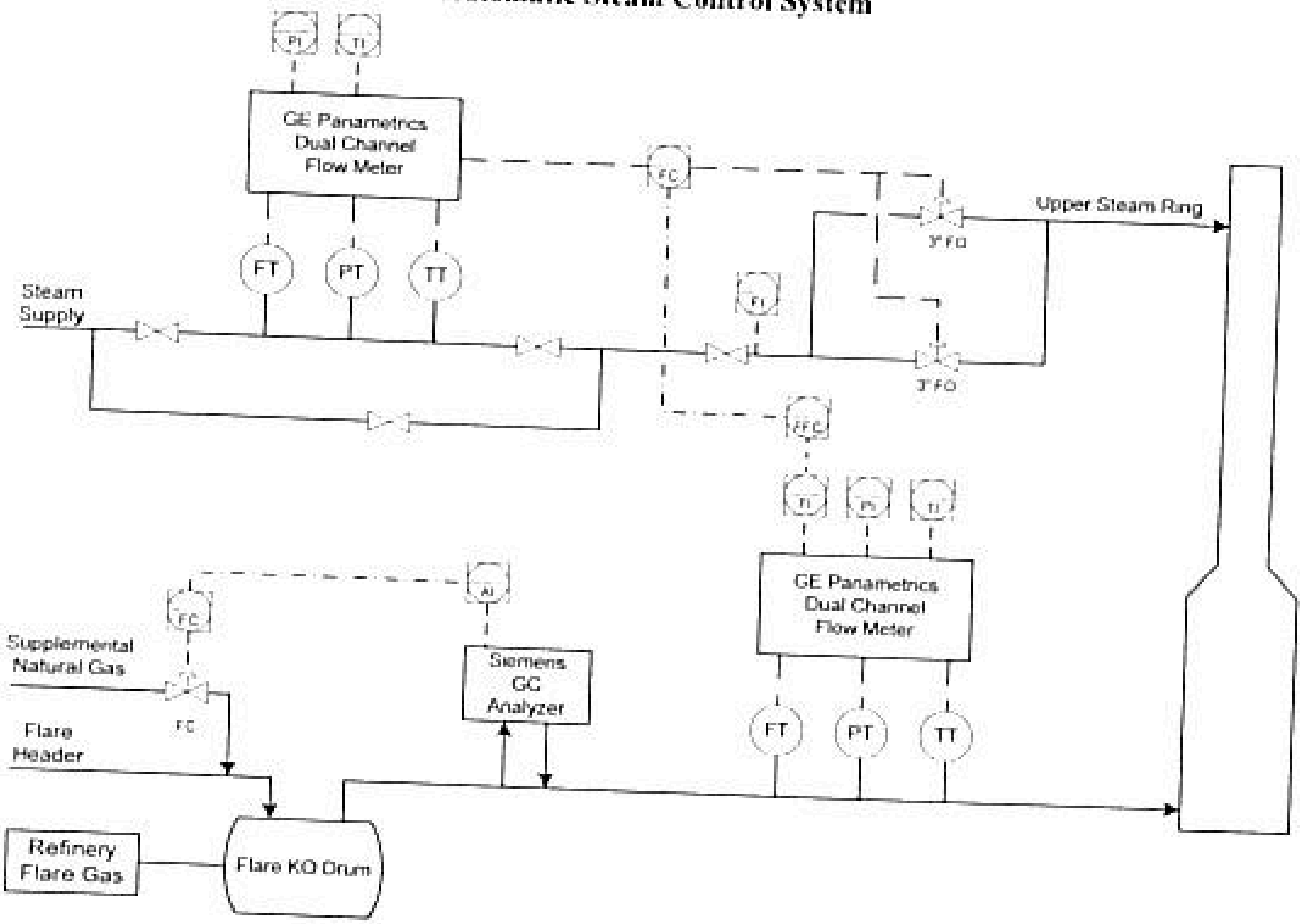
- One pressure control valve is located on the solvent compressor suction drum (Vessel # 2-31-F-4) in the SDA unit. This valve is only operated under Startup, Shutdown, or Malfunction events.
- One pressure control valve is located on the Penex 2nd stage compressor suction drum (Vessel # 2-35-F-10) in the Isom unit. This source is inherently low in sulfur and covered under Subpart J exclusions.
- One pressure control valve is located on the Stripper Tower overhead receiver (Vessel #2-119-F-3) in the #2 SRU. This valve is only operated under Startup, Shutdown, or Malfunction events.
- One pressure control valve is located on the Foul Water System Gas Stripper (Vessel # 2-119-F-2) in the #2 SRU. This valve is only operated under Startup, Shutdown, or Malfunction events.
- One pressure control valve is located on the Acid Gas Separator (Vessel # 2-119-F-1) in the #2 SRU. This valve is only operated under Startup, Shutdown, or Malfunction events.
- One pressure control valve is located on the Acid Gas Separator (Vessel # 2-106-F-301) in the #1 SRU. This valve is only operated under Startup, Shutdown, or Malfunction events.
- One pressure control valve is located on the Foul Water System Gas Separator (Vessel #2-106-F-302) in the #1 SRU. This valve is only operated under Startup, Shutdown, or Malfunction events.
- One pressure control valve is located on the SCOT Stripper off-gas pot (Vessel # 2-106-F-304) in the #1 SRU. This valve is only operated under Startup, Shutdown, or Malfunction events.
- One pressure control valve is located on the Auxiliary Foul Water System Stripper (Vessel # 2-106-D-104) in the #1 SRU. This valve is only operated under Startup, Shutdown, or Malfunction events.
- One pressure control valve is located on the high pressure separator (Vessel #2-102-F-4) hydrogen line in the HPCCR unit. This source was tested and determined to be inherently low in sulfur. An Alternative Monitor Plan (AMP) was submitted to US EPA for this source on 12/18/09.
- One pressure control valve on a hydrogen compressors supply line in the NPT unit. This valve is only operated under Startup, Shutdown, or Malfunction events.
- One split range control valve is located on process feed drum (Vessel # 2-35-F-1) in the Isom unit. This source was tested and determined to be inherently low in sulfur. An Alternative Monitor Plan (AMP) was submitted to US EPA for this source on 7/15/09.
- One split range control valve is located on the hot oil surge drum (Vessel # 2-35-F-7) in the Isom unit. This source was tested and determined to be inherently low in sulfur. An Alternative Monitor Plan (AMP) was submitted to US EPA for this source on 8/31/10.
- One split range control valve is located on the process feed drum (Vessel # 2-103-F-1) in the LPVGO unit. This source was tested and determined to be inherently low in sulfur. An Alternative Monitor Plan (AMP) was submitted to US EPA for this source on 7/15/09.

- One split range control valve is located on the process feed drum (Vessel # 2-104-F-1) in the HPVGO unit. This source was tested and determined to be inherently low in sulfur. An Alternative Monitor Plan (AMP) was submitted to US EPA for this source on 7/15/09.
- One split range control valve is located on the process feed drum (Vessel # 2-122-F-1) KDS unit. This source was tested and determined to be inherently low in sulfur. An Alternative Monitor Plan (AMP) was submitted to US EPA for this source on 7/15/09.
- One level control valve is located on the vent drum pot (Vessel # 2-35-F-12) in the Isom unit. This source is inherently low in sulfur and covered under Subpart J exclusions.
- One level control valve is located on a hydrogen compressor suction drum (Vessel # 2-108-F-7) in the NNA hydrogen system. This control valve vents sweet butane to the NNA flare when process conditions warrant including SSM events.

SECTION
Flare Monitoring Systems

The proposed steam control system for the New North Area flare is illustrated in Figure 3-1.

Figure 3-1
Automatic Steam Control System



Components of the proposed steam control system are summarized in Table 3-1 with details below.

Table 3-1 Proposed Automatic Steam Control System Components

Parameter	Technique	Vendor	Model
Flare Gas Volumetric/ Mass Flow	Ultrasonic Time of Flight	GE Panametrics	Digital Flow GF868
Steam Mass Flow	Ultrasonic Time of Flight	GE Panametrics	Digital Flow GS868
Flare Gas Composition and Net Heating Value	Gas Chromatography	Siemens	Maxum II
Flare Gas Molecular Weight	Ultrasonic Time of Flight	GE Panametrics (same unit as above)	Digital Flow GF868

Automated steam valves will control steam flow. All data from the system will be collected by the distributive control system (DCS) where the control algorithms reside.

Flare Gas Flow Rate, Temperature, and Molecular Weight

A GE Panametrics ultrasonic flow meter measures flare gas flow rate, temperature and molecular weight. This flare gas includes all vent gas, purge gas, and supplemental gas, as the analyzer is downstream from the points where these streams combine. This information is collected continuously and stored in the facility DCS. It is important to note that this instrument cannot distinguish between components of like molecular weight. For instance, if the molecular weight is 44, it cannot determine if the component is propane or carbon dioxide. Since the steam control requirements would be very different between the two compounds, the molecular weight measurement can't be used independently in the control logic.

It should also be noted that the ultrasonic meter is spanned for the full flow range of the flare system. Manufacturer's specifications indicate reasonable accuracy at low flow conditions. However, it is unknown how sensitive the overall control system may be when this and other instruments are operating at low flow conditions. The ultrasonic flow meter will be field calibrated by manufacturer's representatives. Manufacturer's information for the ultrasonic meter is included in Appendix A for reference.

Flare Gas Composition and Heat Content

A Siemens Maxum II Gas Chromatograph (GC) is provided to monitor the flare gas compositions and heat content (Btu/scf). This device provides an analytical data point approximately once every ten minutes. Each data set will be stored in the facility DCS. These readings will be used to verify the molecular weight readings from the vent gas ultrasonic metering system. The instrument specifications are included in Appendix A for reference.

Steam Flow Parameters

Steam flow will be measured by a GE Panametrics ultrasonic flow meter. Prior to operating, steam control valve positioners will be calibrated and checked for proper operation.

Sulfur Analyzer

A H_2S analyzer module will be installed into the Siemens Gas Chromatograph.

Video Camera/Digital Recorder

Catlettsburg's NNA flare is equipped with a video camera that feeds live data to the board operator in the control room and records data via an Image Vault PRO Command Digital Video Recorder (DVR).

Thermocouple

Marathon has thermocouples on the NNA flare pilots but also utilize an infrared camera to detect pilot flame presence. The infrared camera is tested weekly by physically blocking the view of the camera to the pilot.

Incipient Smoke Point

Pursuant to the results of Marathon's flare testing program, the NNA flare control scheme will utilize an S/VG ratio to set the baseline steam demand based on the flow and molecular weight determinations from the ultrasonic flow monitor.

Meteorological Stations

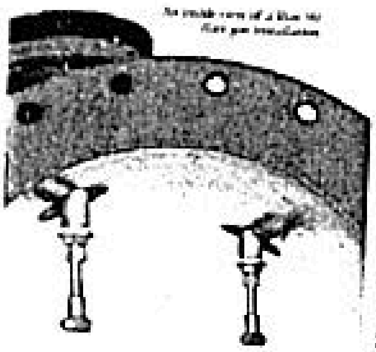
The Catlettsburg Refinery is equipped with a Climatronics meteorological station that is capable of instantaneous wind speed from 0 to 100 mph. This data is transferred to the DCS where it is stored and utilized for momentum flux calculations and flame pattern adjustments during high wind events.

SECTION
Monitoring Methods and Calculations

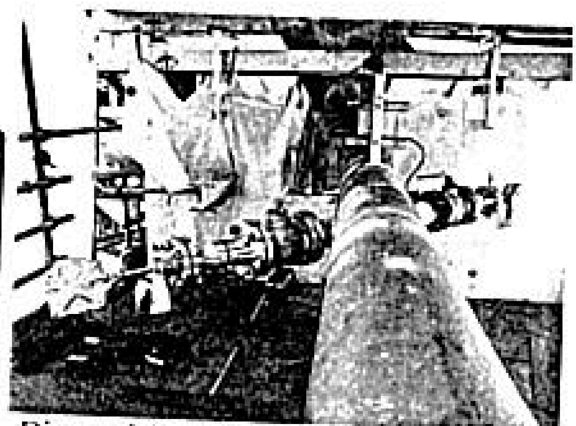
Volumetric Flow –Vent Gas

Panametrics ultrasonic flow meters are used to determine the volumetric flow rate of the flare gas on a continuous basis. The fundamental measurement of the flow meter is gas velocity. Volumetric flow is derived as the product of velocity and the cross-sectional area of the pipe. Volumetric flow is determined independently of the gas composition. The volumetric flow rate is output directly from the flow meter and no external calculations are required.

The flow meter can measure flows from about 0.1 fps to about 280 fps. To retain maximum accuracy over the entire measurement range, a two-channel approach is used. For flows greater than 1 fps, a sensor configuration called the "Bias 90" is used. For flows from 0.1 fps to 1 fps, a second set of sensors is used in the "Diagonal 45" configuration. The Diagonal 45 configuration provides greater resolution due to its longer path length.



Bias 90 configuration



Diagonal 45 configuration

Mass Flow – Steam and Vent Gas

Panametrics ultrasonic flow meters are also used to determine mass flow of steam and vent gas on a continuous basis. The mass flow value is output directly from the flow meter. There are no external calculations that must be performed.

The ultrasonic flow meter is equipped with an algorithm to determine the molecular weight (MW) of the vent gas stream using the measured parameters of pressure, temperature and the speed of sound. This is accomplished with a proprietary algorithm. Once MW is known, the mass is calculated as the product of the MW and the molar flow rate.

A limitation of this technique for determining MW is that it is calibrated for hydrocarbon gases. Nitrogen, when present in the gas stream, introduces error into the determination of MW. The error is proportional to the quantity of nitrogen present. To address this issue, the flow meter can accept a 4-20 mA input signal for nitrogen content. The GC provides this signal at the end of each analytical cycle (~10 min). The flow meter can then compensate for the presence of nitrogen resulting in a more accurate determination of the MW of the gas stream.

Mass Flow – Hydrocarbon

The following hydrocarbons are measured by the GC on a 10 minute cycle.

i	Measured Component	MW	Range	GC Units
1	Methane	16.04	0 - 100	Mole %
2	Ethane	30.07	0 - 100	Mole %
3	Ethylene	28.06	0 - 100	Mole %
4	Acetylene	26.04	0 - 100	Mole %
5	Propane	44.10	0 - 100	Mole %
6	Propylene	42.08	0 - 100	Mole %
7	Iso-Butane	58.12	0 - 100	Mole %
8	Normal Butane	58.12	0 - 100	Mole %
9	i-Butene, Butene-1	56.11	0 - 100	Mole %
10	Trans-Butene-2	56.11	0 - 100	Mole %
11	Cis-Butene-2	56.11	0 - 100	Mole %
12	1,3 Butadiene	54.09	0 - 100	Mole %
13	Pentane-Plus (C5+)	72.15	0 - 100	Mole %

The vent gas mass flow rate will be determined as follows:

$$\dot{m}_{vg} = Q_{vg} \times (MW_{vg}/386)$$

Where

Q_{vg} = Vent Gas Flow Rate

MW_{vg} = Molecular Weight, in pounds per pound-mole, of the Vent Gas, as measured by the Vent Gas Average Molecular Weight Analyzer

Net Heating Value (Lower Flammability Level)

As specified in the Consent Decree, the Net Heating Value of the Vent Gas will be determined by the GC at the conclusion of each analytical cycle (~10-15 minutes). The Net Heating Value is the Lower Heating Value or LHV defined in the Consent Decree as:

"Lower Heating Value" or "LHV" shall mean the theoretical total quantity of heat liberated by the complete combustion of a unit volume or weight of a fuel initially at 25° Centigrade and 760 mmHg, assuming that the produced water is vaporized and all combustion products remain at, or are returned to, 25° Centigrade; however, the standard for determining the volume corresponding to one mole is 20° Centigrade."

The method of calculating the combustion zone net heating value will be based on the lower flammability level of the components in the vent gas and utilize the following steps.

Step 1: <u>Determine LFLs for Each Individual Vent Gas Compound</u>

Take the LFL values of each individual Vent Gas compound from Table 1.

Table 1
Individual Compound Properties

i	j	Compound	NHV_i (Btu/scf)	MW_i (lb/lbmol)	LFL_i (vol fraction)
1		Hydrogen	274 or 1212[1]	2.02	0.040
2		Oxygen	0	32.00	∞
3		Nitrogen	0	28.01	∞
4		CO_2	0	44.01	∞
5		Water	0	18.02	∞
6		CO	316	28.01	0.125
7	1	Methane	896	16.04	0.050
8	2	Ethane	1595	30.07	0.030
9	3	Ethylene	1477	28.05	0.027
10	4	Acetylene	1404	26.04	0.025
11	5	Propane	2281	44.10	0.021
12	6	Propylene	2150	42.08	0.024
13	7	iso-Butane	2957	58.12	0.018
14	8	n-Butane	2968	58.12	0.018
15	9	iso-Butene	2928	56.11	0.018
16	10	trans-Butene	2826	56.11	0.017
17	11	cis-Butene	2830	56.11	0.016
18	12	1,3-Butadiene	2690	54.09	0.020
19	13	Pentane+ (C_5+)	3655	72.15	0.014
20	14	Benzene[2]	3591	78.11	0.013

Note: i = all compounds, j = organic compounds

[1]If using an H_2-adjusted NHV_{vg} or NHV_{cz}, then use 1212 BTU/scf for hydrogen.

[2]Benzene not required unless it is expected in the vent gas in measurable quantities.

Step 2: <u>Calculate the LFL of the vent gas mixture.</u>

The average lower flammability limit of the vent gas is calculated by Le Chatelier's equation shown below as Equation 1. This calculation uses the weighted average of the LFLs of the individual compounds weighted by their volume percent of the vent gas. All inerts, including nitrogen, are assumed to have an infinite lower flammability limit (e.g. $LFL_{N2} = \infty$). All constants and variables are defined in the Key at the end of this document.

$$LFL_{vg} = \frac{1}{\sum_{i=1}^{n}\left(\frac{x_i}{LFL_i}\right)} \qquad \textit{Equation 1}$$

Step 3: Determine the Net Heating Value of the Vent Gas (NHV_{vg})

If a Gas Chromatograph is used: The net heating value of the vent gas is calculated and reported from the GC at the conclusion of each analytical cycle (~10-15 minutes). Equation 2 is used by the GC to calculate the vent gas net heating value from each individual compound net heating value. Individual compound volume fractions are measured directly by the GC. Individual compound net heating values are listed in Table 1 below.

$$NHV_{vg} = \sum_{i=1}^{n}(x_i \cdot NHV_i) \qquad \textit{Equation 2}$$

Step 4: Calculate the NHV_{vg} at its LFL ($NHV_{vg\text{-}LFL}$)

Using LFL_{vg} from Equation 1 and NHV_{vg} from Equation 2 the $NHV_{vg\text{-}LFL}$ is calculated by Equation 3.

$$NHV_{vg\text{-}LFL} = NHV_{vg} \cdot LFL_{vg} \qquad \textit{Equation 3}$$

Step 5: Multiply $NHV_{vg\text{-}LFL}$ by the Combustion Efficiency Multipliers to calculate the $NHV_{cz\text{-}limit}$

The Net Heating Value of the Gases in the Combustion Zone (NHV_{cz}) of a Flare that is needed to ensure an acceptable Combustion Efficiency is determined by multiplying $NHV_{vg\text{-}LFL}$ by Combustion Efficiency Multipliers appropriate to the flare category and the volume percent of hydrogen in the Vent Gas as defined in Table 2.

Table 2
Combustion Efficiency Multipliers for Steam-Assisted Flares: Variables Based on Minimum Steam Requirements and VOC Concentration in the Vent Gas

Minimum Steam	VOC Vent Gas Concentration	A Multiplier	B Multiplier*	
			Condition A	Condition B
≤ 1000 lb/hr	≤ 20.0%	6.0	4.0	0.0
≤ 1000 lb/hr	> 20.0%	6.5	4.0	0.0
> 1000 lb/hr	≤ 20.0%	6.75	4.0	0.0
> 1000 lb/hr	> 20.0%	7.0	4.0	0.0

*The B Multiplier used depends on the relationship of hydrogen and propylene in the vent gas as follows:
Condition A: $3 \leq H_2\% \leq 8$ and Propylene% $\geq H_2\%$ (all percents are volume or mole percents)
Condition B: Any condition not meeting the requirements for Condition A.

Note: The specifications for Condition A may change as new information from tests or research becomes available.

The Net Heating Value of Combustion Zone Gas Limit is calculated as follows:

$$NHV_{cz-limit} = \left(A + B \cdot x_{propylene}\right) \cdot NHV_{vg-LFL} \qquad \textit{Equation 4}$$

Step 6: Calculate the Net Heating Value of the Combustion Zone Gas (NHV_{cz})

The NHV in the combustion zone (NHV_{cz}) combines the NHVs of the Vent Gas, pilot gas, and steam and is calculated by Equation 5. The NHV of steam is assumed to be zero. Vent Gas mass flow rate ($\dot{m}_{vg}$) and steam mass flow rate ($\dot{m}_s$) are measured by on-line flow meters. The pilot gas mass flow rate ($\dot{m}_{pg}$) is constant for each flare and set by an orifice.

$$NHV_{cz} = \frac{\left(\frac{\dot{m}_{vg} \cdot NHV_{vg}}{MW_{vg}}\right) + \left(\frac{\dot{m}_{pg} \cdot NHV_{pg}}{MW_{pg}}\right)}{\left(\frac{\dot{m}_{vg}}{MW_{vg}}\right) + \left(\frac{\dot{m}_{pg}}{MW_{pg}}\right) + \left(\frac{\dot{m}_s}{MW_{H_2O}}\right) + \left(\frac{\dot{m}_{air}}{MW_{air}}\right)} \qquad \textit{Equation 5}$$

The values for $\dot{m}_s$ and $\dot{m}_{air}$ are determined as follows based on the type of flare:

Steam-Assisted Flare without Minimum Steam Reduction System (MSRS)

$\dot{m}_s = measured\ value$

$\dot{m}_{air} = 0$

Steam-Assisted Flare with MSRS

$\dot{m}_s = measured\ value$

$\dot{m}_{air} = result\ from\ Equation\ 13\ in\ Step\ 6a$

OR

$\dot{m}_{air} = 0$ *with vendor certification that the MSRS equipment installed on the flare is not capable (even at minimum vent gas flow) of inspirating more than twice the stoichiometric volume of air into the vent gas.*

* Note – NNA flare will not have MSRS

The molecular weight of the vent gas (MW_{vg}) is calculated by the GC using Equation 6. An on-line ultrasonic flow meter may also be used to calculate MW_{vg}. Individual compound molecular weights are listed in Table 1.

$$MW_{vg} = \sum_{i=1}^{n}(x_i \cdot MW_i) \qquad \textbf{\textit{Equation 6}}$$

The NHV of the pilot gas (NHV_{pg}) and MW of the pilot gas (MW_{pg}) are calculated using Equations 7 and 8, respectively. These calculations are similar to the vent gas calculations, except the individual compound volume fractions are that of the pilot gas and not the vent gas. Individual compound volume fractions are measured by laboratory analysis of a pilot gas sample, or may be taken from the natural gas supplier's laboratory certificate of analysis.

$$NHV_{pg} = \sum_{i=1}^{n}(pg_i \cdot NHV_i) \qquad \textbf{\textit{Equation 7}}$$

$$MW_{pg} = \sum_{i=1}^{n}(pg_i \cdot MW_i) \qquad \textbf{\textit{Equation 8}}$$

Step 7: Ensure that during flare operation, $NHV_{cz} \geq NHV_{cz\text{-}limit}$

The flare must be operated to ensure that NHV_{cz} is equal to or above $NHV_{cz\text{-}limit}$ to ensure an acceptable combustion efficiency. Equation 14 shows this relationship.

$$NHV_{cz} \geq NHV_{cz-limit} \qquad \textbf{\textit{Equation 14}}$$

Key to the Abbreviations:

0.21 = *mole fraction of oxygen in air* (0.21 *lb-mol* O_2/*lb-mol air*)
A = *overall combustion efficiency multiplier for* NHV_{vg-LFL} (*unitless*)
B = *olefin combustion efficiency multiplier for* NHV_{vg-LFL} (*unitless*)
C_{vg} = *concentration of VOC in the vent gas* (*vol %*)
i = *individual numbered compound from column i in Table 1* (*unitless*)

j = individual numbered compound from column j in Table 1 (unitless)
LFL_i = lower flammability limit of individual compound (vol %)
LFL_{vg} = lower flammability limit of vent gas (vol %)
$\dot{m}_{air}$ = mass flow rate of air (lb/hr)
$\dot{m}_{air-MSRS}$ = total mass flow rate of air introduced by an MSRS (lb/hr)
$\dot{m}_{air-stoich-vg}$ = stoichiometric air flow for the vent gas(lb/hr)
$\dot{m}_{O2-stoich}$ = stoichiometric oxygen mass flow for an individual compound (mol/hr)
$\dot{m}_{O2-stoich-vg}$ = stoichiometric oxygen mass flow for the vent gas (lb/hr)
$\dot{m}_{pg}$ = mass flow rate of pilot gas (lb/hr)
$\dot{m}_s$ = mass flow rate of total steam (lb/hr)
$\dot{m}_{vg}$ = mass flow rate of vent gas (lb/hr)
MW_{H_2O} = molecular weight of water (18.02 lb/lb-mol)
MW_{O_2} = molecular weight of oxygen (32.0 lb/lb-mol)
MW_{air} = molecular weight of air (28.9 lb/lb-mol)
MW_{pg} = molecular weight of pilot gas (lb/lb-mol)
MW_{vg} = molecular weight of vent gas (lb/lb-mol)
n = list of individual compounds from Table 1 (unitless)
NHV_{cz} = net heating value of the combustion zone (BTU/scf)
NHV_i = net heating value of individual compound (BTU/scf)
NHV_{vg-LFL} = net heating value vent gas at lower flammability limit (BTU/scf)
$NHV_{cz-limit}$ = limit net heating value of the combustion zone (BTU/scf)
NHV_{pg} = net heating value of pilot gas (BTU/scf)
NHV_{vg} = net heating value of vent gas (BTU/scf)
pg_i = individual compoound volume fraction in pilot gas (vol fraction)
x = carbon flow rate for a given organic compound (mol/hr)
x_i = individual compound volume fraction in the vent gas (vol fraction)
x_j = individual organic compound volume fraction in the vent gas (vol fraction)
$x_{propylene}$ = volume fraction of propylene in the vent gas (vol fraction)
y = hydrogen flow rate for a given organic compound (mol/hr)

The "VOC Vent Gas Concentration" shall be calculated on an annual average basis as follows:

$$C_{vg} = \sum_{j=3}^{n} x_j * 100 \qquad \textbf{\textit{Equation 16}}$$

Note: The summation does not include methane or ethane.

Steam Ratios

The consent decree requires the calculation of one steam ratio. It will be calculated as follows:

The Actual Total Steam to Vent Gas Ratio will be calculated as follows:

$$\frac{S}{VG}$$

Where
S = Actual Total Steam Mass Rate (scf/min) calculated above
VG = Vent Gas Mass Rate (scf/min) as measured by the ultrasonic flow monitor Direct measurement - no external calculation required

Appendix A

Equipment Specification Sheets

- GE Panametrics – GS868 Manufacturer's Specifications
- GE Panametrics – GF868 Manufacturer's Specifications
- Siemens – Maxum II Manufacturer's Specifications

Appendix B

Supporting Documentation

- 1998 Original Flare Design Specifications
- Current (1998) Flare Tip Assembly
- Manufacturer's Email - Steam